EPA – UNDERGROUND INJECTION CONTROL PERMIT APPLICATION NO. ID2D001-A

Applicant: AM Idaho LLC
Well Name: DJS Properties #2-14

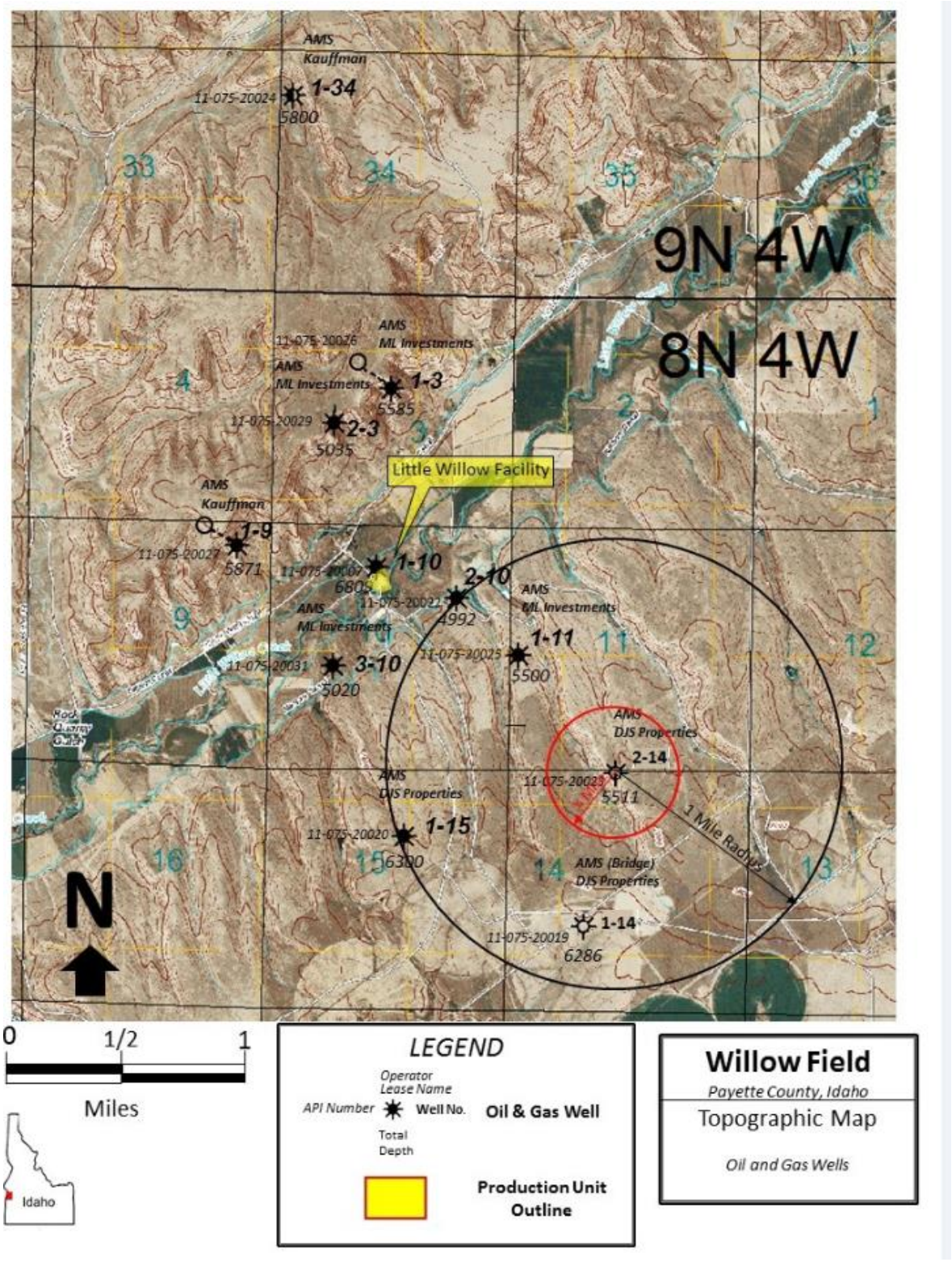
Table of Contents

AREA OF REVIEW - 40 CFR 146.6 requires that the area of review (AOR) for each injection well or each field, project or area of the State be determined per either paragraph (a) or (b) of the regulation. Based on the remote location of the well and the lack of potential pathways which may cause the migration of the injection and/or formation fluid into an underground source of drinking water, AM Idaho LLC has adopted the ¼ mile fixed radius to define the project AOR provided for in the regulations (i.e., 40 CFR 146.6(b)). Specifically, the AOR for this application encompasses a ¼ mile radius circle from the wellbore.

ATTACHMENT B: Maps of Well/Area and Area of Review

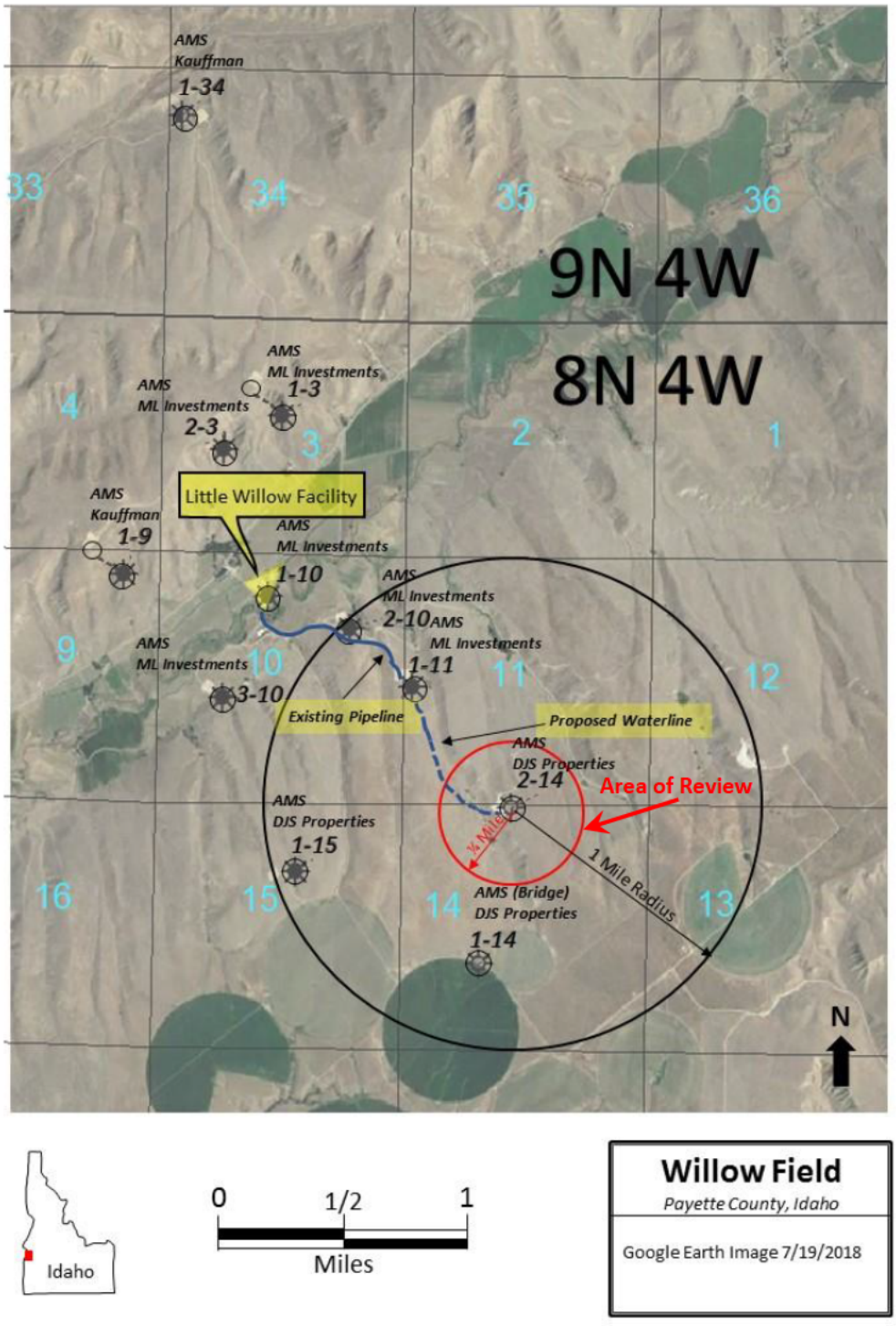
B-1 Topographic Map of Well/Area and Area of Review

A. TOPOGRAPHIC MAP OF WELL/AREA AND AREA OF REVIEW - There are no notable wells, springs, water bodies, etc. within the 1/4 mile radius Area of Review. This area is the Willow Oil and Gas Field, existing oil and gas wells are shown on the map. Produced oil, gas, and water flows through existing flowlines and is collected at the Little Willow Facility (Att. B-3)



B-2 Google Earth Image of Area of Review

MAPS OF WELL/AREA AND AREA OF REVIEW - Google Earth Image of Area of Review. The aerial photo below shows the existing flowline from the Little Willow Production Facility as well as the proposed flowline which extends from the ML Investments #1-11 well site to the DJS Properties #2-14 well site (proposed water injection site).



B-3 Google Earth Image of Little Willow Production Facility (LWPF)

MAPS OF WELL/AREA AND AREA OF REVIEW - Google Earth Image of Little Willow Production Facility (LWPF). The LWPF collects raw production via pipelines from area wells: separates oil, condensate, natural gas, and water. Storage tanks for liquids. Water is currently hauled out by truck.

Google Earth Image 7/19/18

B-4 Google Earth Image of DJS 2-14

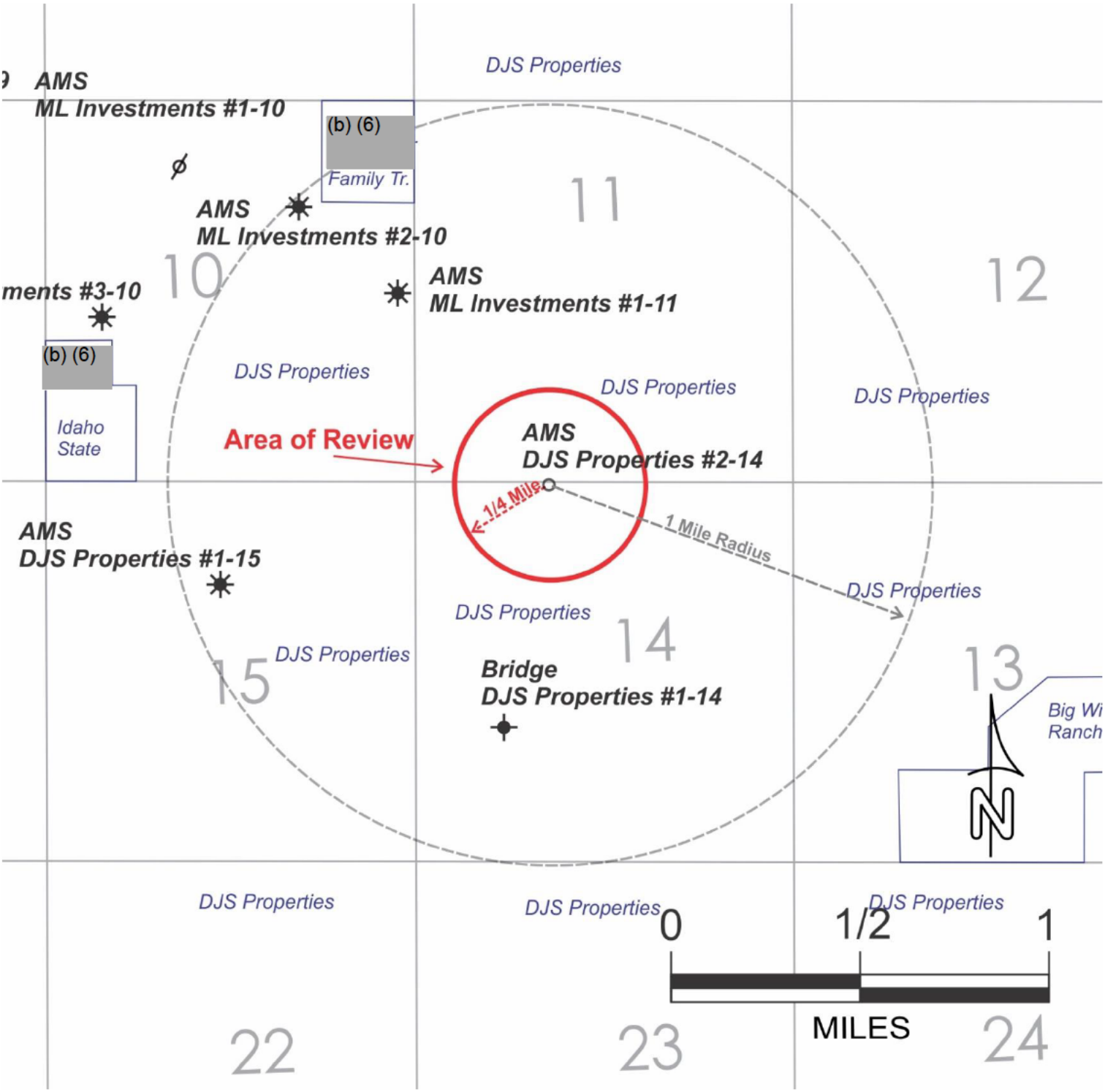
EPA – UNDERGROUND INJECTION CONTROL PERMIT APPLICATION ATTACHMENTS

MAPS OF WELL/AREA AND AREA OF REVIEW – Google Earth Image of DJS #2-14 Well Pad, the proposed injection well.

Google Earth Image 7/19/18

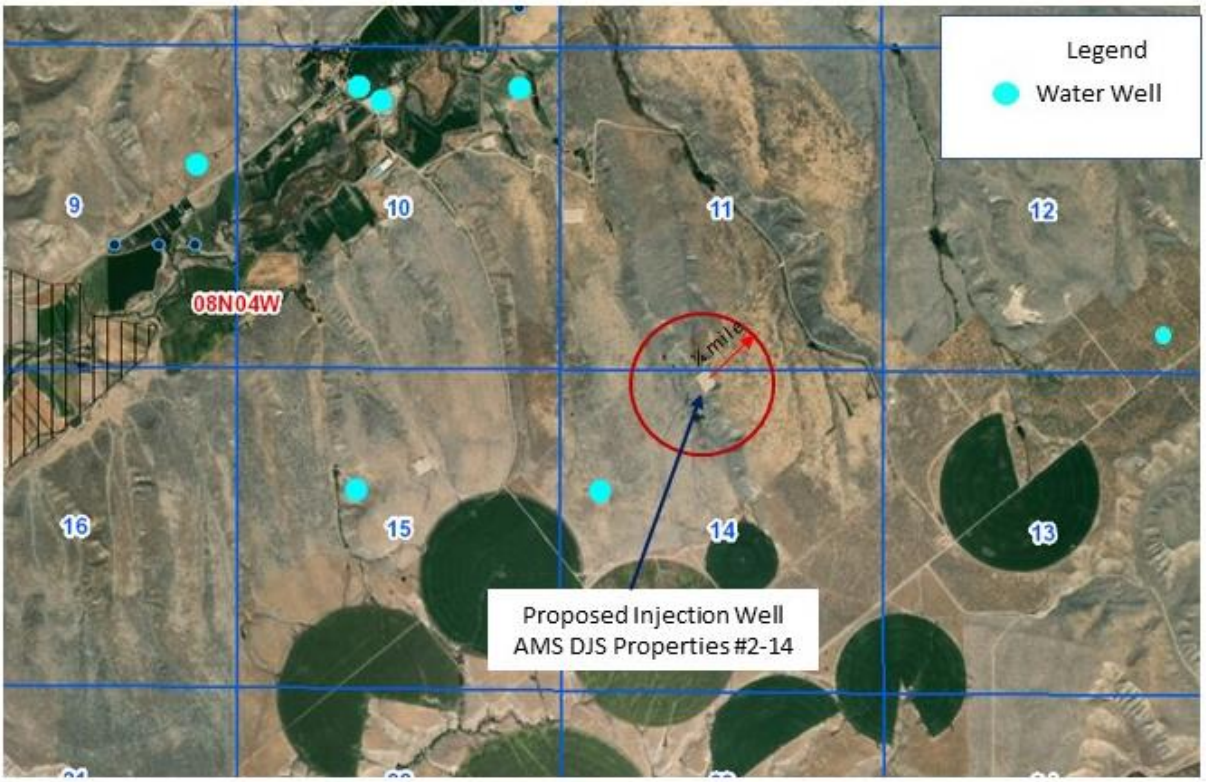
B-5 Property Ownership Map for Area of Review

Property Ownership Map for Area of Review. 100% of the property within the area of review is owned by DJS Properties.



ATTACHMENT C: Corrective Action Plan and Well Data

CORRECTIVE ACTION PLAN AND WELL DATA - There are no water wells within the area of review.



Ggeogle Earth Areal Image
Idaho Department of Water Resources – Idaho.gov

E. NAME AND DEPTH OF UNDERWATER SOURCES OF DRINKING WATER (USDW) (CLASS II)

Geologic Data on Shallow Aquifers, and Injection and Confining Zones

[1]Spencer H. Wood, PhD. PG
Consulting Geologist
June 17, 2019

Sediments above the proposed injection zone (4,910-5,500 ft depth in DJS 2-14) are ~2,000 ft of the lacustrine mudstone/claystone Chalk Hills Formation, overlain by 860 ft of mudstone/claystone of the lower Glenns Ferry Formation (**Figs. E-1 and E-2**). The upper Glenns Ferry Formation (above 1,410 ft depth) is dominantly mudstone/claystone, but contains several fine-sand units 10-50 ft thick regarded as stacked turbidite sands within prodelta mudstones. The "Digital Files for Injection Permit and Appendices" folder has digital files for these figures.

An uppermost sand unit identified as the Pierce Gulch sand (Wood, 2004) occurs in the surrounding hills above 2,400 ft elevation where it is up to 250 ft thick. In the Willow field area the Pierce Gulch sand appears to be < 100 ft thick and may be absent most wells. In the 185-ft deep (b) (6) domestic well ~1.7 miles northwest of DJS 2-14 (**Fig. E-1**), the upper 161 feet is described as claystone and siltstone, with sandstone from 161-185 ft depth (**Appendix E**, Hydrologic, Inc., 2014, Figure 5). This well is likely in the prodelta sands and not in the Pierce Gulch sand. Other water wells are in the shallow alluvium of Little Willow Creek.

We did a very complete water flow testing and water analysis of two existing wells in this area prior to our developing Willow Field. This was to establish "baseline" levels of any contaminants already in the water shed. One of these reports (b) (6) well) is attached in **Appendix E**.

Three miles south of the proposed DJS 2-14 injection well, the regional SW dip and minor faulting places the base of the Pierce Gulch sand down to elevation ~1,600, where it is ~600 ft thick (**Fig. E-2**). In these wells to the south ((b) (6) (b) (6) the Pierce Gulch sand is the important sand aquifer that occurs over much of the western plain to the south at similar depth and elevation (Wood, 1994).

The turbidite sands within the underlying prodelta mudstones are discontinous aquifers that are rarely developed as a water supply because of depth. The upper Glenns Ferry Formation is interpreted as a regressive unit comprised of a delta-prodelta sequence prograding to the southwest in response to lowering lake levels as the lake drained 3 to 2.5 Ma ago

The lower Glenns Ferry Formation is interpreted as a transgressive lacustrine mud, as Pliocene Lake Idaho filled during the late Miocene (Wood, 1994; Barton, 2019). No sands are within these muds in the Willow field area, and logs show very low (~ 1 ohm m) monotonous resistivity typical of clay-rich mudstones.

Contact of the lower Glenns Ferry Formation mudstones with the underlying thick mudstones of the Chalk Hills Formation has no identifying characteristic on resistivity logs. Resistivity is continually low downward without a break. The contact is difficult to recognize in field mapping of exposures 3.2 miles to the northeast. In exposures "the Chalk Hills Formation is typically more massive than the Glenns Ferry Formation, lighter in color, and contains more clay (likely bentonite). Soils typically have medium to small surface cracks of expansive clays" (Lewis et. al. in preparation, 2019). In the DJS 2-14 well the contact is chosen on density logs at 2,380 ft depth where density increases from 1.95 to 2.05 g/cm3 at and then increases monotonically downward to 2.27 g/cm3 at 4,300 ft depth (**Fig. E-2**). The abrubt increase suggests an unconformity with the underlying, slightly denser mudstone. The monotonic downward increase in density is characteristic of

increasing claystone compaction with depth. The contact is also expressed by a downward increase on the gamma log from 75 to 90 API.

Beneath the ~2,000' thick mudstone/claystone of the Chalk Hills Formation, the mudstone section is invaded by a 120-ft thick basalt sill (4,370-4,490 ft depth)(**Fig. E-2**). Several basalt sills are in the deep section imaged by 2D and 3D seismic, occurring as saucer shaped lenses extending laterally up to one mile. Mudstone continues down to 4,910 ft depth, below which is the Willow sand section of the proposed injection zone (4,910-5,500 ft). These sands were called sands of the lower Chalk Hills Formation, but in a new interpretation by Barton (2019), the sill and all sediments below 4,320 ft are regarded as the Payette Formation, an older, middle Miocene fluvial-lacustrine unit unconformably overlain by the Chalk Hills Formation. In outcrop ~10 miles east of DJS 2-14, the Payette Formation is quite tuffaceous with thick (> 100 ft) bentonitic clay layers, rare arkosic sand units, and characteristically has steeper dips of ~15° south. Regardless of the formation assignment, the injection zone Willow sands are clearly overlain by the 2000 ft thick Chalk Hills mudstone/claystone, an additional 860 ft of lower Glenns Ferry mudstone/claystone, and occur in the isolated fault block in the vicinity of proposed injection well DJS 2-14.

References

Barton, M. 2019. Neogene lacustrine systems and sequence stratigraphy of the western Snake River Basin. ppt presentation. Idaho Geological Survey, 41 pages.

Hydrologic, Inc., 2014. Measurement and sampling of the (b) (6) Domestic well. Report to Alta Mesa Services, LP. 34 pages.

Lewis, R., Feeney, D., Wood, S.H., Breedlovestrout, R. in preparation-2019. Geologic Map of the Sheep Ridge 7.5-minute Quadrangle, 1:24,000. Idaho Geological Survey, Moscow, Idaho.

Wood, S.H., 1994. Seismic expression and geological significance of a lacustrine delta in Neogene deposits of the western Snake River Plain, Idaho: American Association of Petroleum Geologists Bulletin, v. 78, p. 102-121. internet:

https://pdfs.semanticscholar.org/3a7a/e47722b59de87c78e83bd2eeb7656338a997.pdf

Wood, S.H. 2004. Geology across and under the western Snake River Plain, Idaho: Owyhee Mountains to the Boise Foothills (Chapter 7). in Haller, K.M. and Wood, S.H. (eds.), Geological Field trips in southern Idaho, eastern Oregon, and Northern Nevada. U. S. Geological Survey Open-File Report 2004-1222. p. 84-107. Internet: http://pubs.usgs.gov/of/2004/1222.

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[1]Spencer Wood is an emeritus professor of geology and geophysics at Boise State University. Education is a degree in Geophysical Engineering from Colorado School of Mines, 1964; MS in geophysics, 1972 and PhD in Geology from Caltech 1975. Former positions with Mobil Oil International, US Geological Survey and visiting professor at University of Oregon, Chiang Mai University-Thailand and National University Singapore. Research on regional geology and geophysics, neotectonics, volcanology, borehole geophysics, hydrogeology and geomorphology. Consulting for Los Alamos National Laboratory, United Water Idaho, Inc., Idaho Dept. Water Resources, Simplot Foods, Hydrologic, Inc., Alta Mesa LP, Thailand Dept. Water Resources, Thailand Dept. Energy Development. Registered Professional Geologist-Idaho No. 616.

Figure E-1

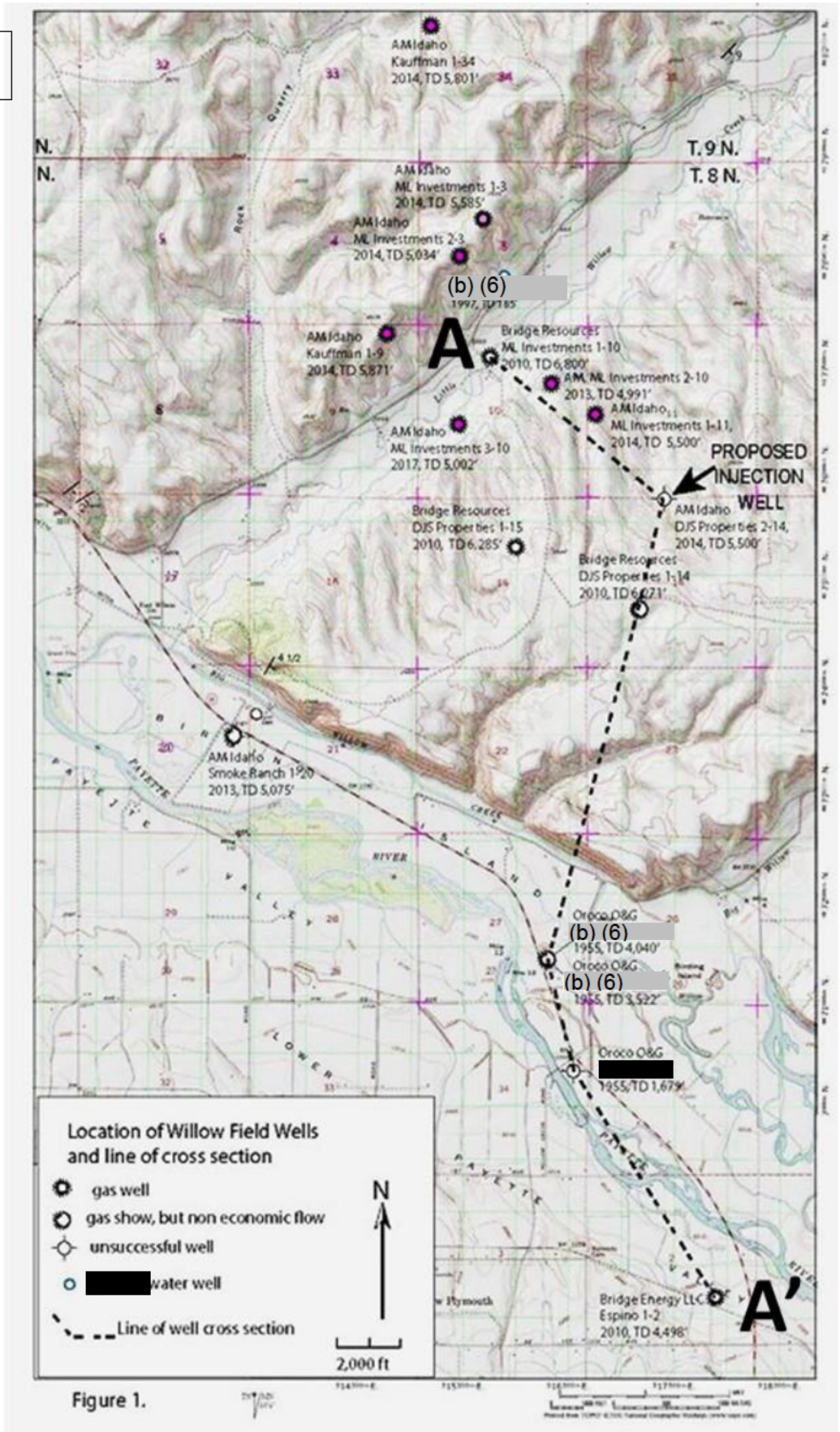


Figure 1.

Figure E-2

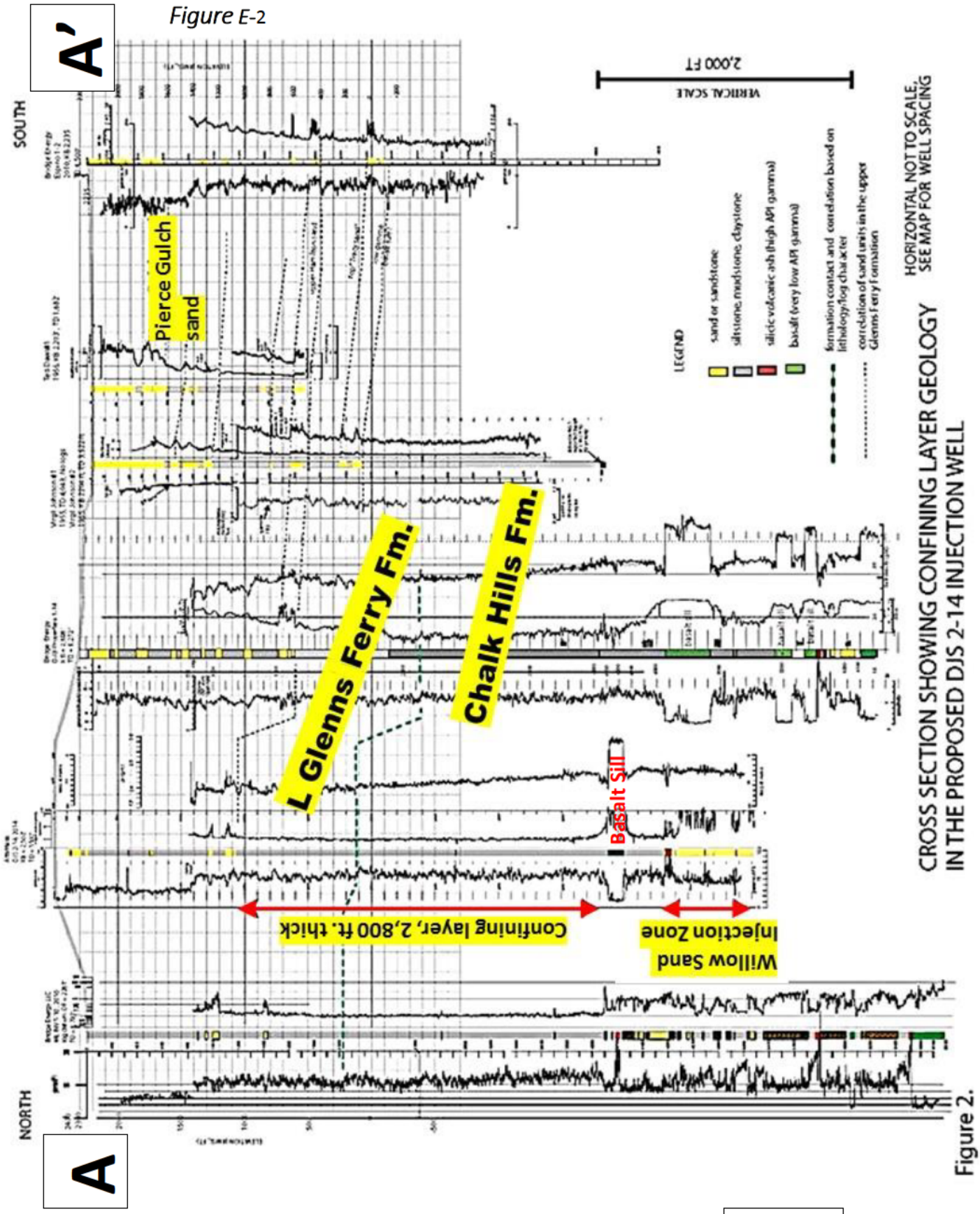


Figure E-2

ATTACHMENT G: Geological Data on Injection and Confining Zones (Class II)

G. GEOLOGICAL DATA ON INJECTION AND CONFINING ZONES (Class II) - In the DJS Properties 2-14 well the proposed injection zone is in the Willow Sand, which is dominantly composed of several hundred feet of massive porous and permeable quartz rich sandstones. The massive sandstones also contain minor thin shaly sandstone and claystone layers which vary in size both vertically and laterally in the section **(See *Figure G-1*)**. G-1 is a composite lithologic type log of the DJS #2-14 from the surface to its total depth of 5500', then the deeper section is added on from the ML #1-10 well, which penetrated the deeper section of the Willow Sands. Per well log correlation the top of the injection zone occurs at 4,910' TVD and is 590' in gross thickness (5,500' Well TD). The confining zone is both the overlying Glenns Ferry Formation and the upper and middle Chalk Hills formation. These formations are very widely distributed in this basin and are typically very impermeable clays. In the DJS Properties 2-14 well the Glenns Ferry formation (approx. 250'-2380' TVD) is composed of highly impermeable lacustrine Claystone, as well as scattered arkosic sandstones. The upper and middle Chalk Hills formation (approx. 2,380'-4,910'TVD) contains more lacustrine clays, silicic volcanic ash, and basalt.

The Willow Sands are a thick section of Miocene age lacustrine and fluvial sands deposited in a gradually subsiding basin. The Western Snake River Basin (WSRB) began rifting and subsiding in middle Miocene time, coincident with and following eruption of the Columbia River Basalts (17 – 12 MYA). Basalts were extruded, and volcanic ash and marsh sediments were laid down as the basin continued to subside. As the basin deepened, a lake (Lake Idaho) was formed and fluvial sands and sediment washed into and continued filling the basin. The Payette Formation and the Willow Sands member of the lower Chalk Hills formation represent these early sediments. As the basin continued to subside, drainage outlets were blocked allowing a lake of great depth (over 1000 feet in depth) to form. The middle and upper Chalk Hills formation represent this phase of deposition, it is composed of 2,000' to 3500' of claystones and ash. See **Figure G-2 and Figure G-3** modified from Barton, Idaho Geologic Survey, 2019 (pre-publication). **Figure G-2** is a location map over the northeast margin of the basin. ***B-B'*** indicates a line of cross-section from near the basin margin on the east, then westerly across the Willow Field and into the basin. **Figure G-3** is the regional cross-section ***B-B'*** which incorporates the exploratory wells drilled and demonstrates the geologic history described above. The salient points demonstrated here relative to this injection well discussion are these:

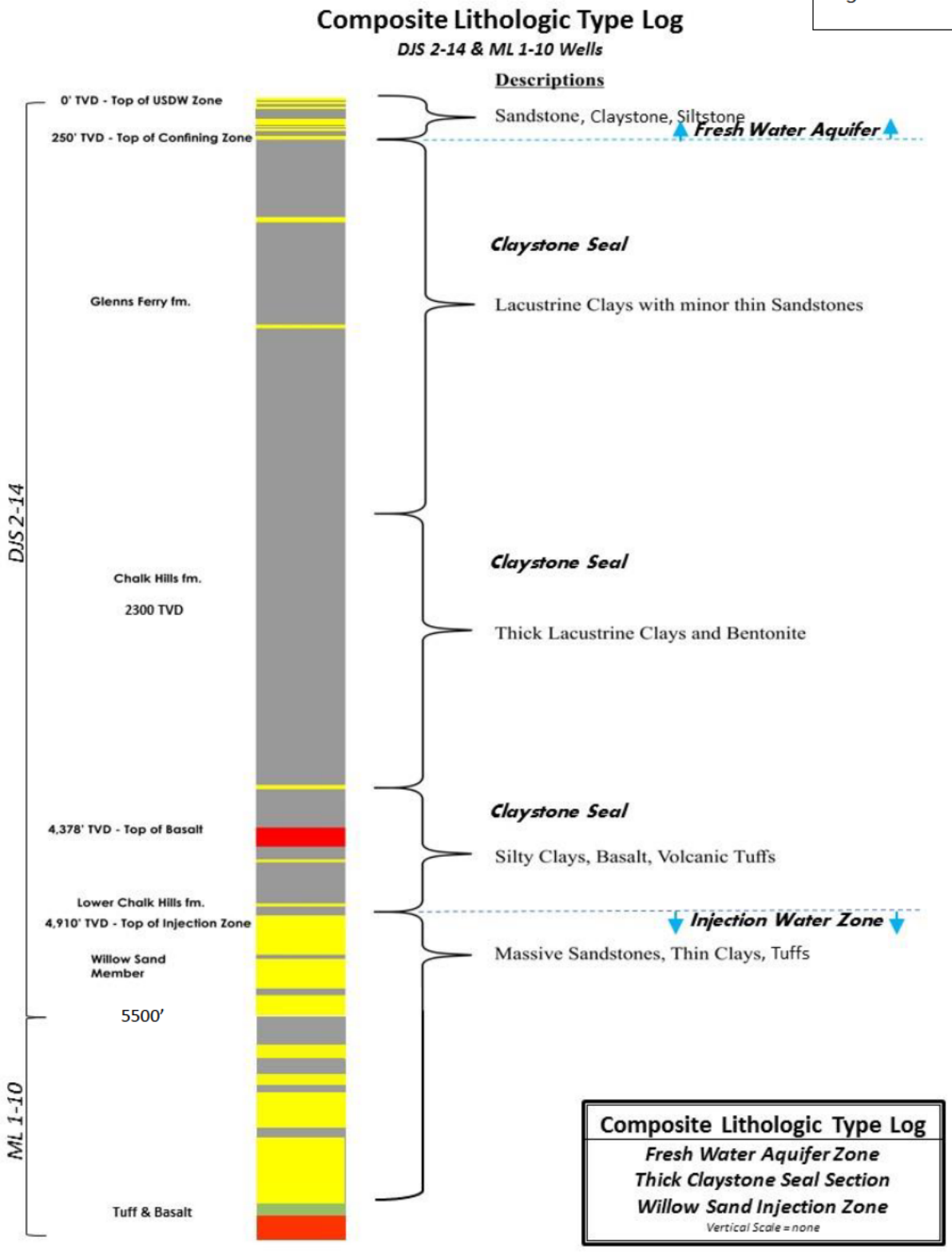
1. Thick Chalk Hills claystones provide a widespread and extremely competent series of top-seals above the Willow Sands.
2. The small faults present locally are early, syn-depositional and die out (cease movement) in the overlying Chalk Hills claystones.
3. The shallow aquifers in use in the basin are separated from the Willow Sands at depth by thick Chalk Hills and Glenns Ferry claystones.

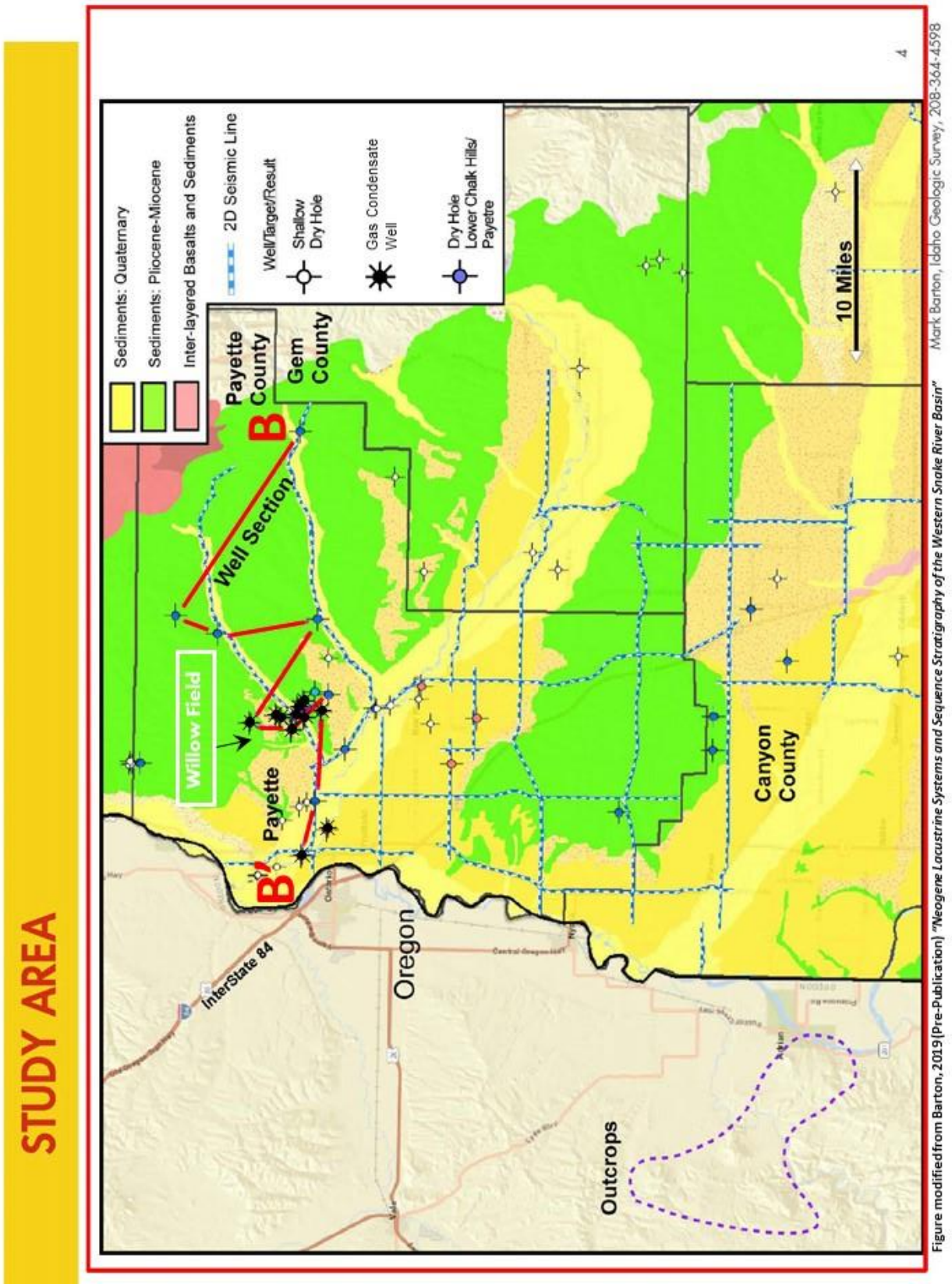
An important point to note is that because these Chalk Hills and Glenns Ferry clays are lacustrine (deposited in a lake), they are uniformly widespread, and also very thick. Because the clays and tuffaceous clays are soft, they make very impermeable and competent confining layers.

Local wells drilled deeper than the DJS 2-14 show that the Willow Sands can be 1500' to 2000' thick (ML 1-10). Underlying the Willow Sands and interbedded with the lower sands are ash beds, tuffaceous claystones and basalts, these can provide competent confining layers. **Figure G-4** is a regional base map which shows the DJS 2-14 and logs from several surrounding wells. Subsequent figures **(G-5 thru G-9)** are larger scale versions of these well logs. Note that the conforming overlying claystone zones are from 2,400' to 3,600' thick in these wells. Digital files for the open hole logs and mud logs of each of these wells are available in the "Digital Files for Injection Permit and Appendices" folder.

G-1 DJS 2-14 Composite Lithological Section

Figure G- 1

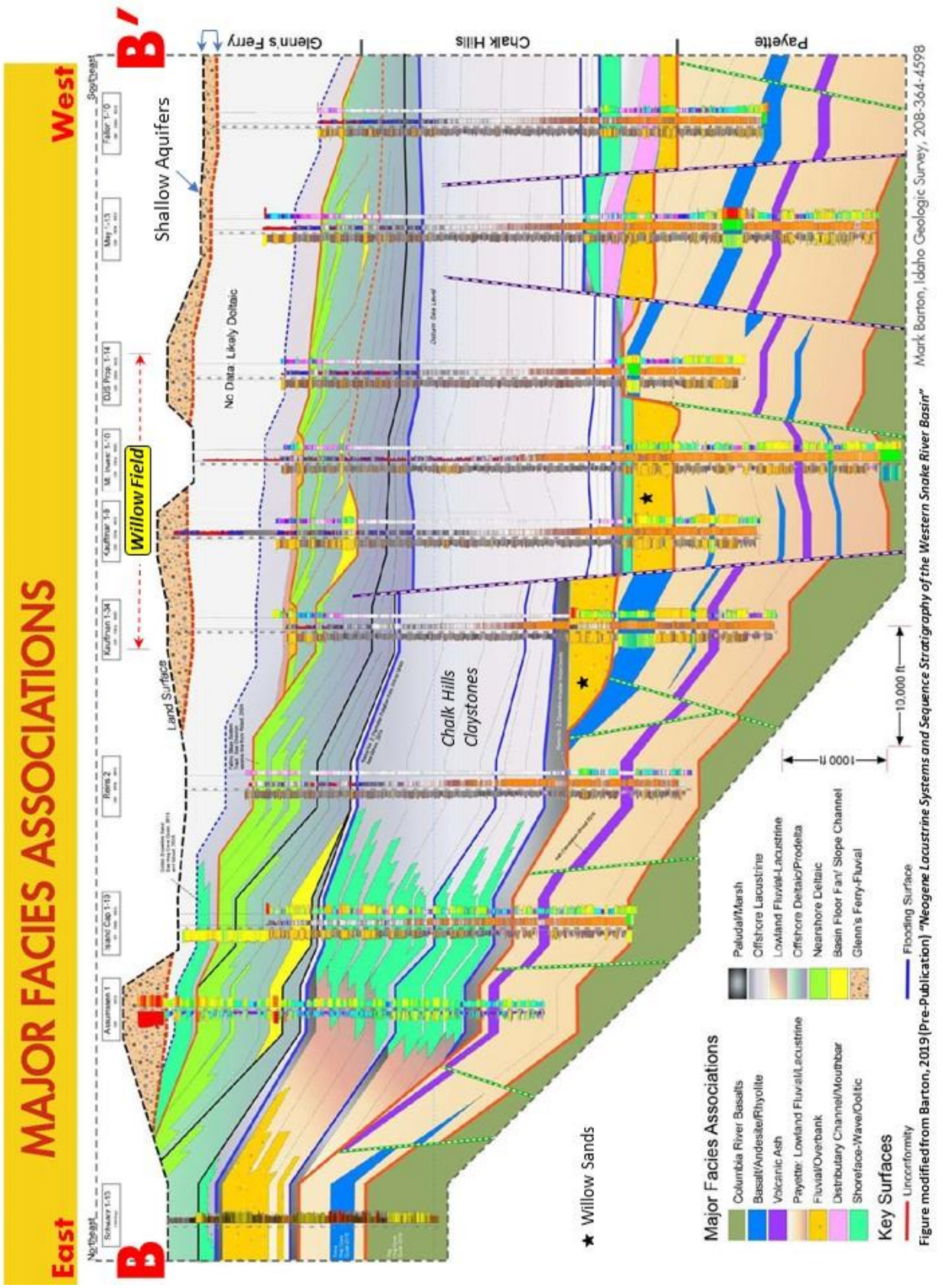




Mark Barton, Idaho Geologic Survey, 208-364-4598

Figure G-2

Figure G-2



Mark Barton, Idaho Geologic Survey, 208-364-4598

Figure G-3

Figure G-3

Figure G- 4

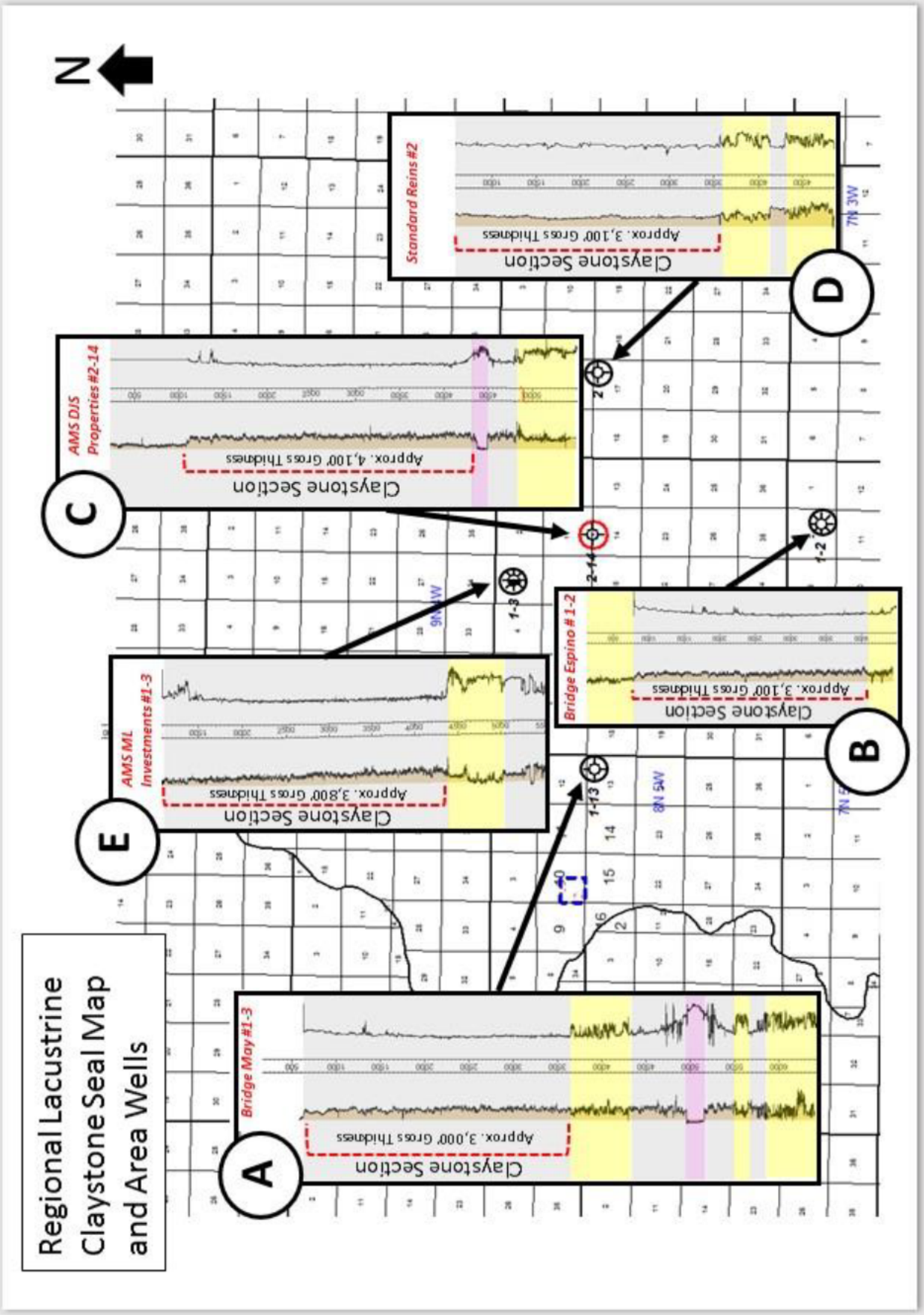

N
Regional Lacustrine Claystone Seal Map and Area Wells
A
Bridge May #1-3
Approx. 3,000' Gross Thickness
Claystone Section
B
Bridge Espino #1-2
Approx. 3,100' Gross Thickness
Claystone Section
C
AMS DJS Properties #2-14
Approx. 4,100' Gross Thickness
Claystone Section
D
Standard Reins #2
Approx. 3,100' Gross Thickness
Claystone Section
E
AMS ML Investments #1-3
Approx. 3,800' Gross Thickness
Claystone Section
1-3
2-14
1-2
2
1-13
9N 6W
8N 5W
7N 3W
7N 2W

Figure G- 5

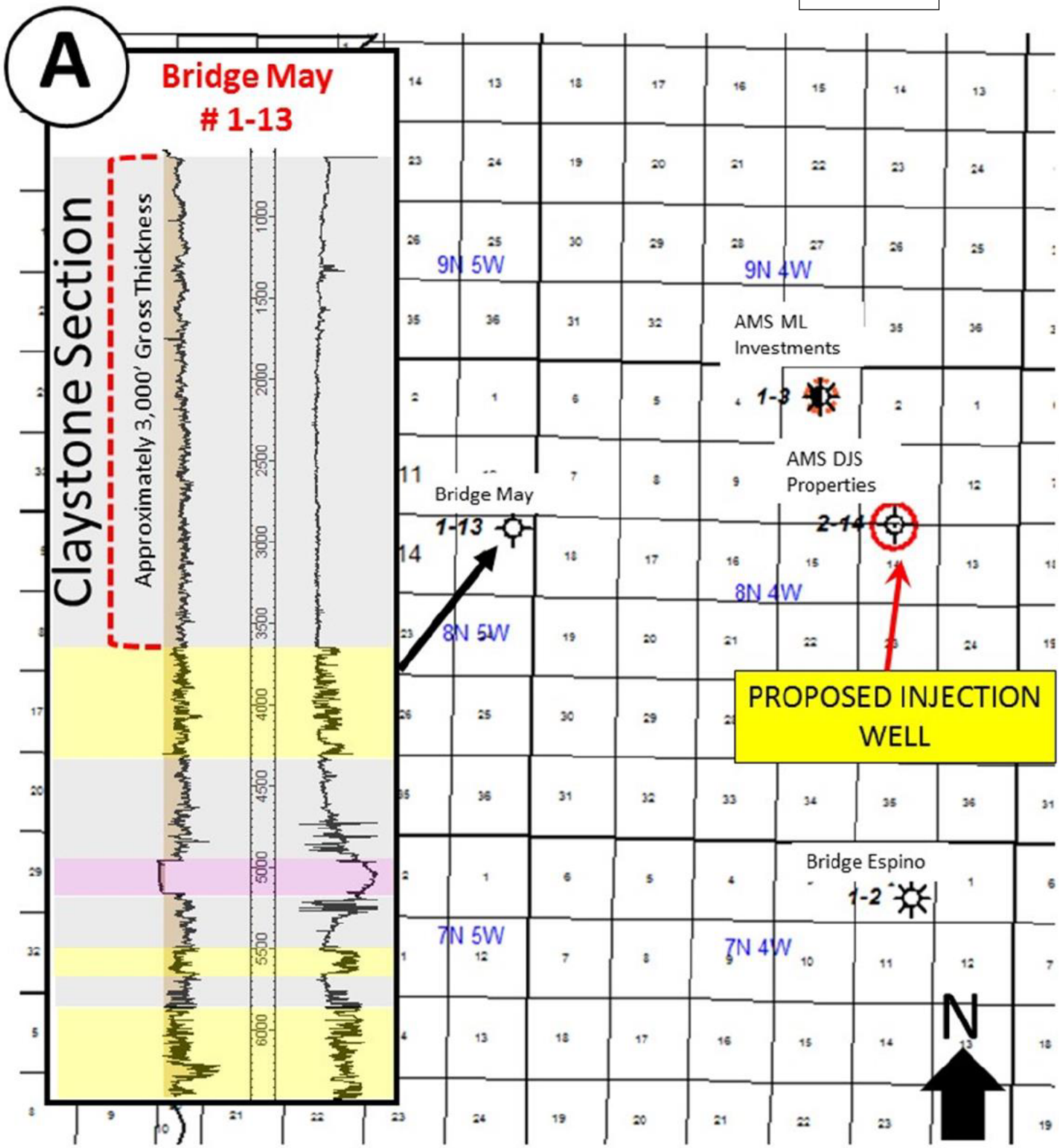

A
Bridge May
1-13
Claystone Section
Approximately 3,000' Gross Thickness
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
9N 5W
9N 4W
AMS ML
Investments
1-3
AMS DJS
Properties
2-14
Bridge May
1-13
8N 4W
8N 5W
PROPOSED INJECTION
WELL
Bridge Espino
1-2
7N 5W
7N 4W
N

Figure G- 6

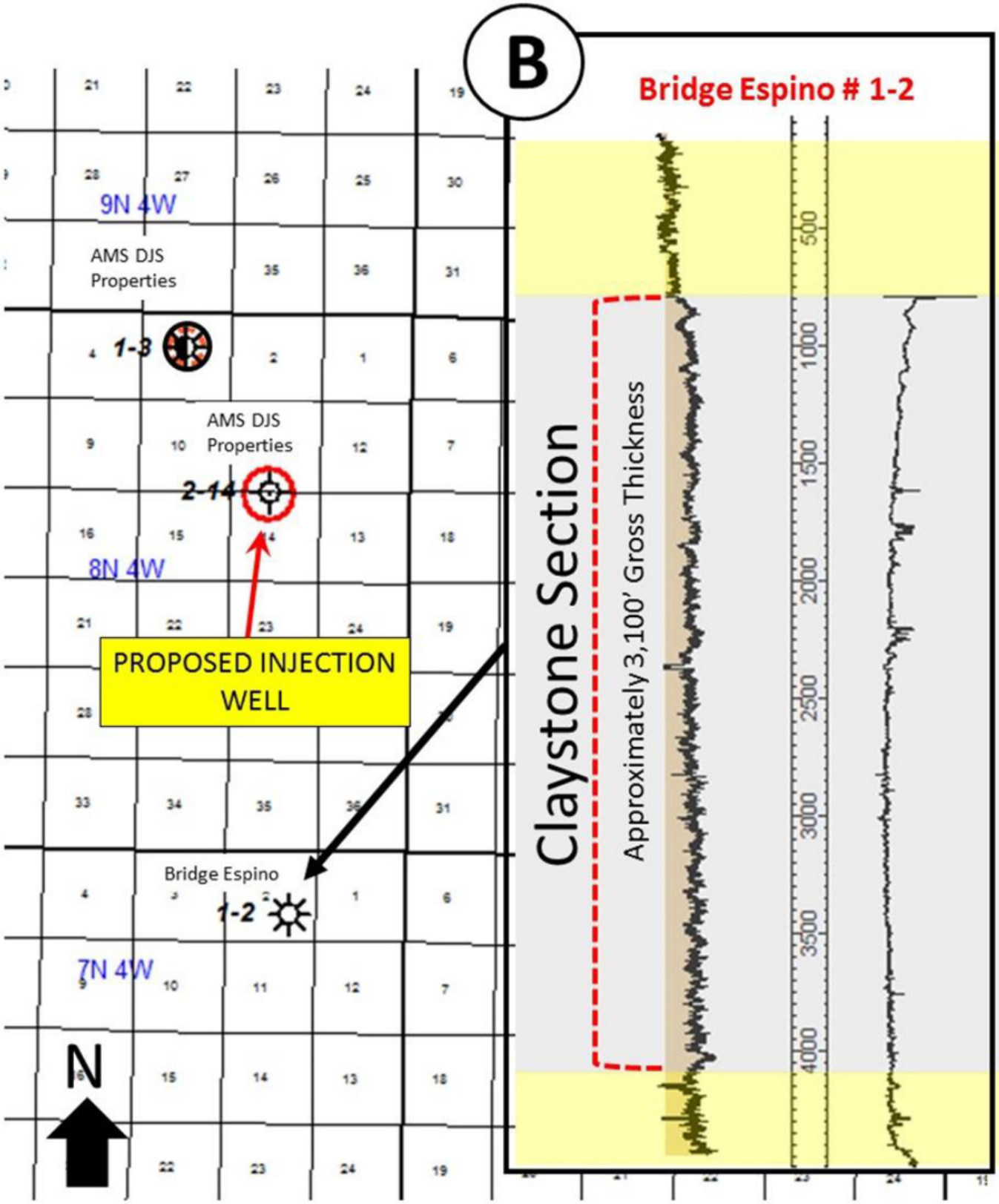

B
Bridge Espino # 1-2
Claystone Section
Approximately 3,100' Gross Thickness
500
1000
1500
2000
2500
3000
3500
4000
9N 4W
AMS DJS Properties
1-3
AMS DJS Properties
2-14
8N 4W
PROPOSED INJECTION WELL
Bridge Espino
1-2
7N 4W
N

Figure G- 7

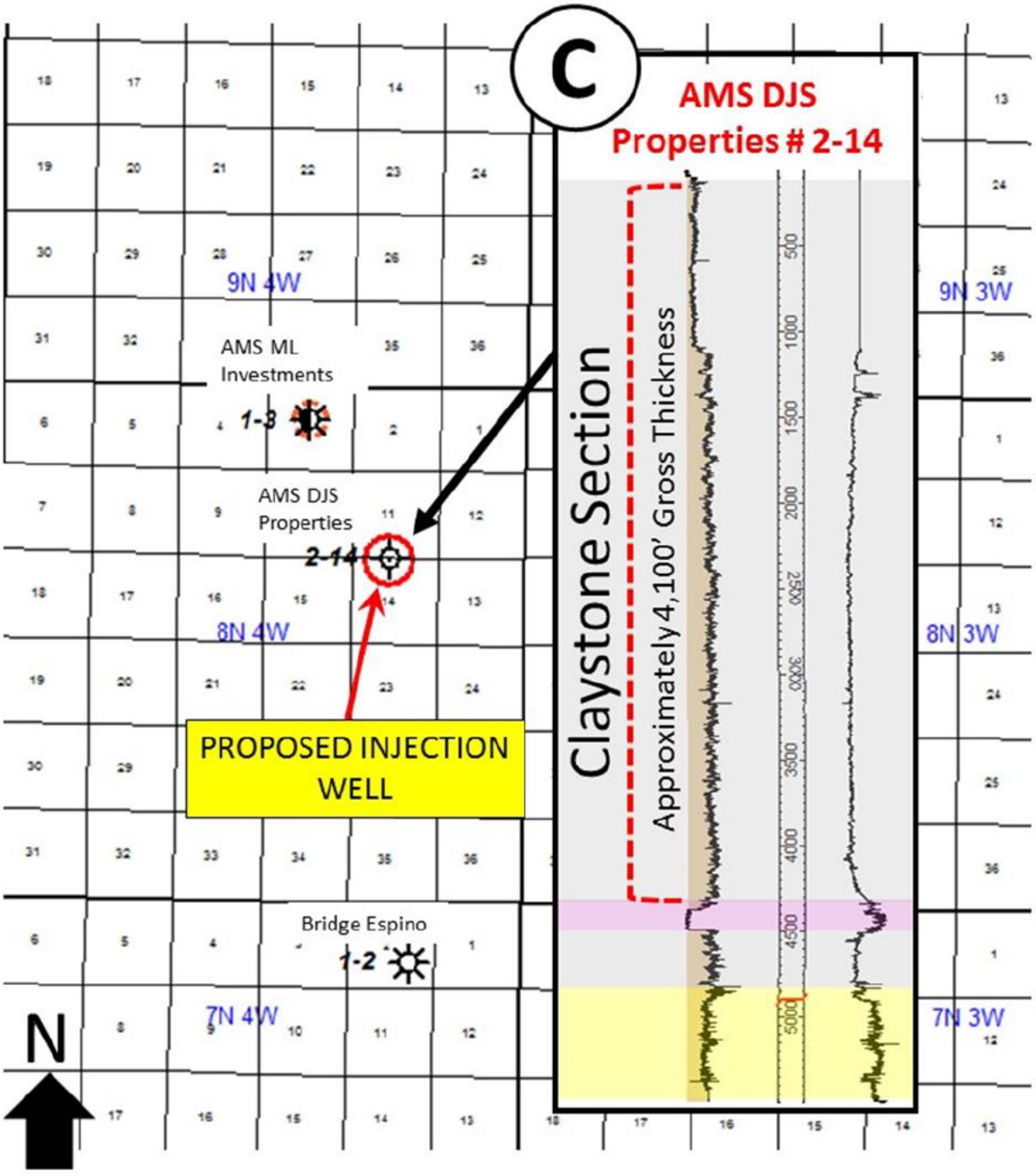

C
AMS DJS
Properties # 2-14
Claystone Section
Approximately 4,100' Gross Thickness
9N 4W
9N 3W
AMS ML
Investments
1-3
AMS DJS
Properties
2-14
8N 4W
8N 3W
PROPOSED INJECTION
WELL
Bridge Espino
1-2
7N 4W
7N 3W
N

Figure G-8

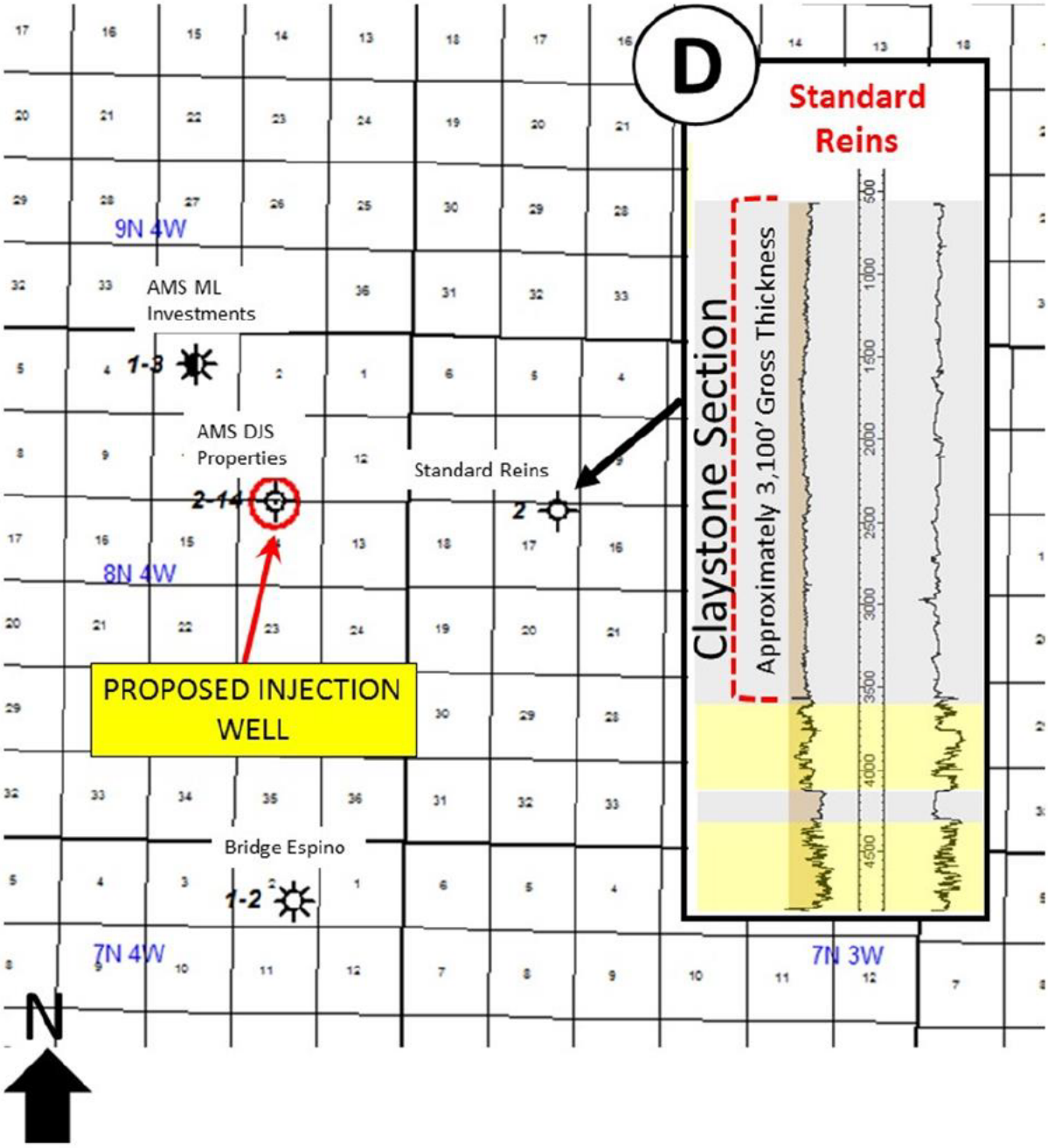
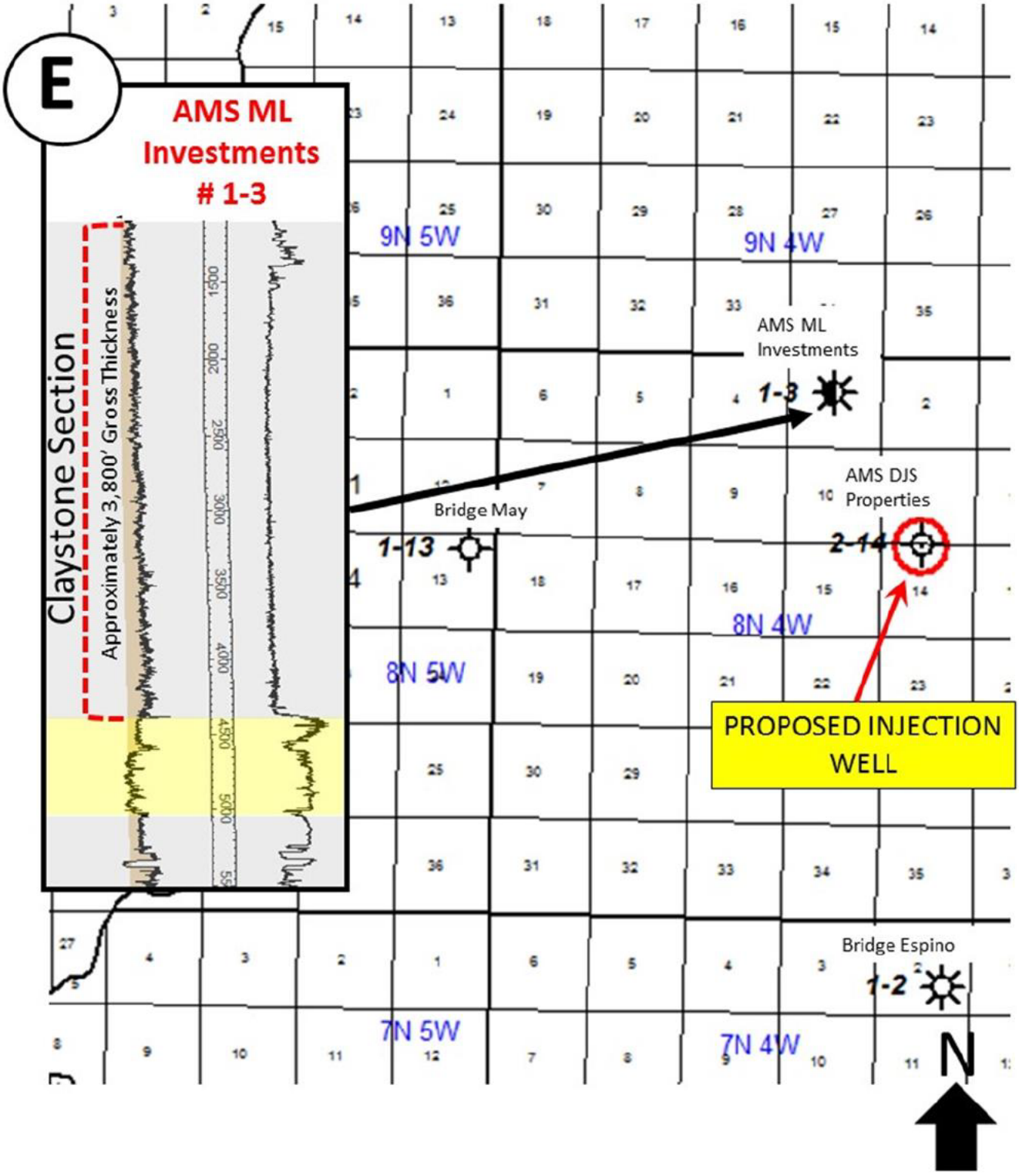

D
Standard Reins
Claystone Section
Approximately 3,100' Gross Thickness
9N 4W
AMS ML Investments
1-3
AMS DJS Properties
2-14
Standard Reins
2
8N 4W
PROPOSED INJECTION WELL
Bridge Espino
1-2
7N 4W
7N 3W
N

Figure G- 9


E
AMS ML Investments # 1-3
Claystone Section
Approximately 3,800' Gross Thickness
9N 5W
9N 4W
AMS ML Investments
1-3
Bridge May
1-13
AMS DJS Properties
2-14
8N 4W
8N 5W
PROPOSED INJECTION WELL
Bridge Espino
1-2
7N 5W
7N 4W
N

Discussion of Geological and Geophysical Evaluation Methods Used.

Early study of this area included:

1. Review of a very broad array of prior geologic study in the published literature for regional understanding,
2. Several basin-wide multi-day geologic field trips,
3. Study of prior unsuccessful oil and gas well attempts from 1900 to 2010 – logs, cuttings, etc.

In 2012 we designed and acquired a 49 square mile 3-D seismic survey, centered on this area. The data were processed using refraction statics in Houston, Texas. We interpreted the data and came up with exploration prospects. We drilled the discovery well (ML #2-10) and several successful development wells in what is now Willow Field.

See **Figure G-10** for a structure map at the top of the Willow Sands – which is the oil and gas reservoir for the field. The Field is a 4-way structural closure bisected by small (50' – 250') syndepositional faults.

Figure G-11-A is a NW-SE structural **cross-section C-C'** that runs through 3 wells producing oil and gas from the Willow Sands, and the proposed injection well (DJS 2-14). The log curves shown to the left of each wellbore are the Gamma Ray Logs, and demonstrate the Willow Sands location and thickness. **Figure G-11-B** shows the 3-D seismic data that the interpretation is derived from. The detailed interpretation shown is a result of having high quality seismic data with 82.5' bins.

Figure G- 10

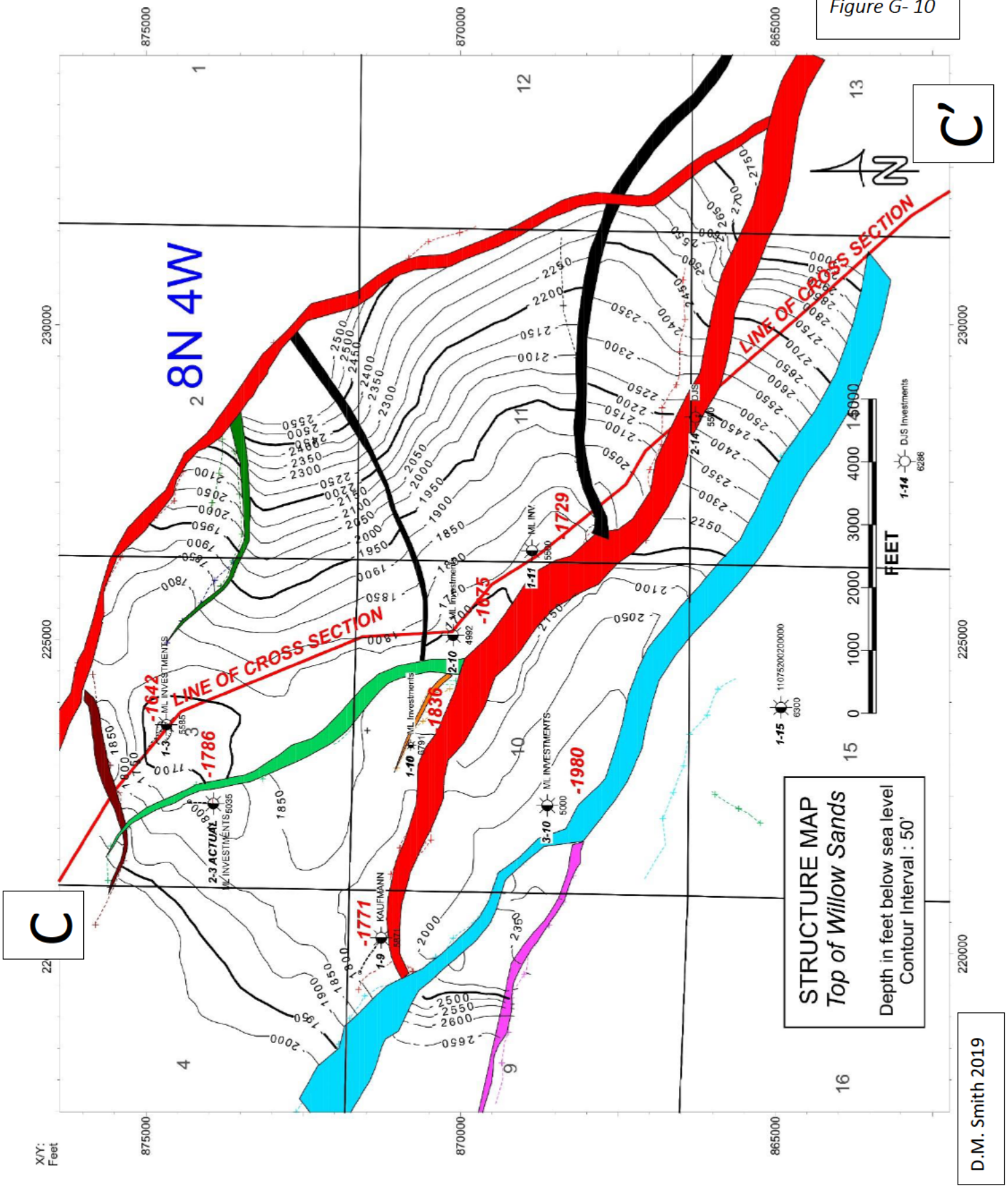
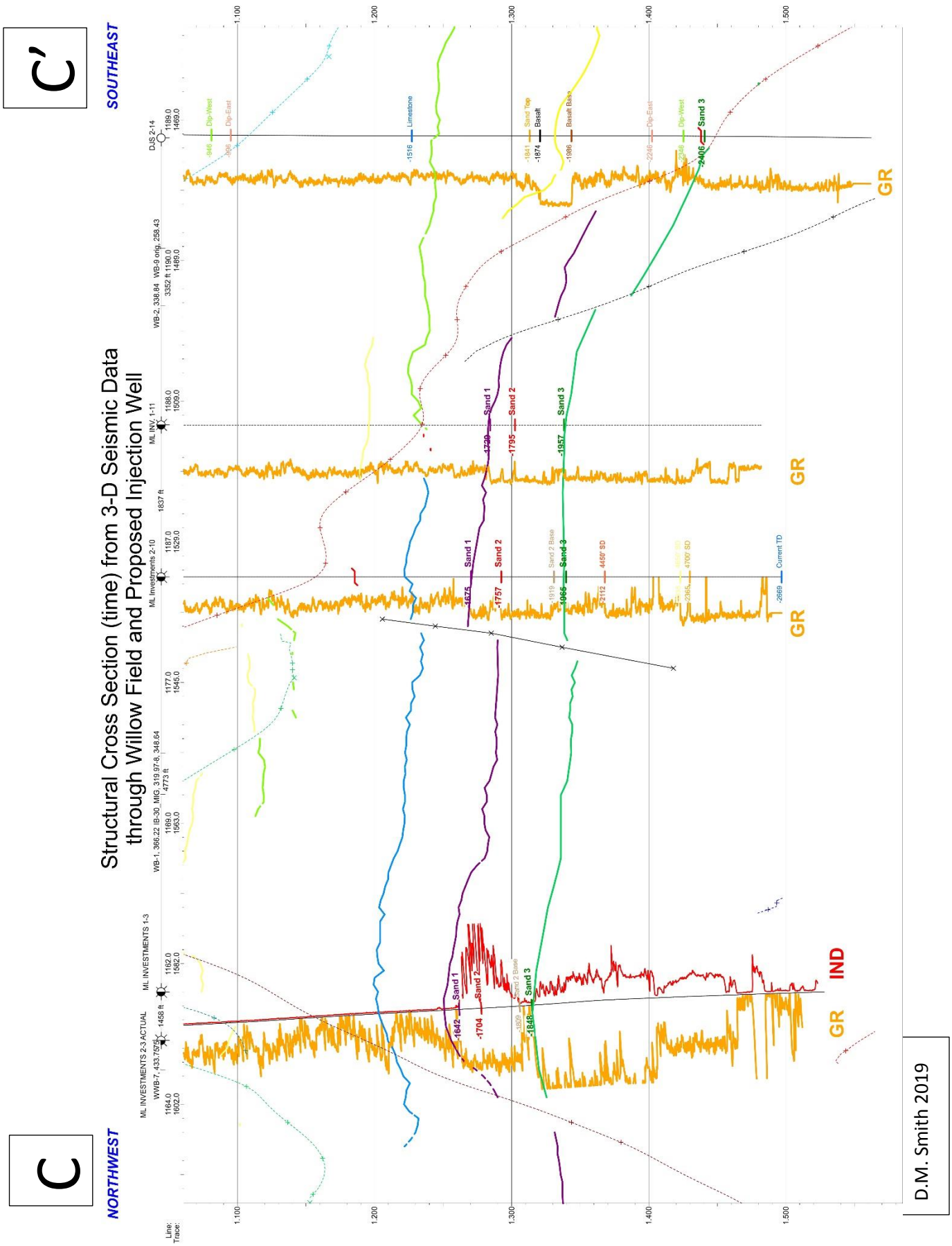
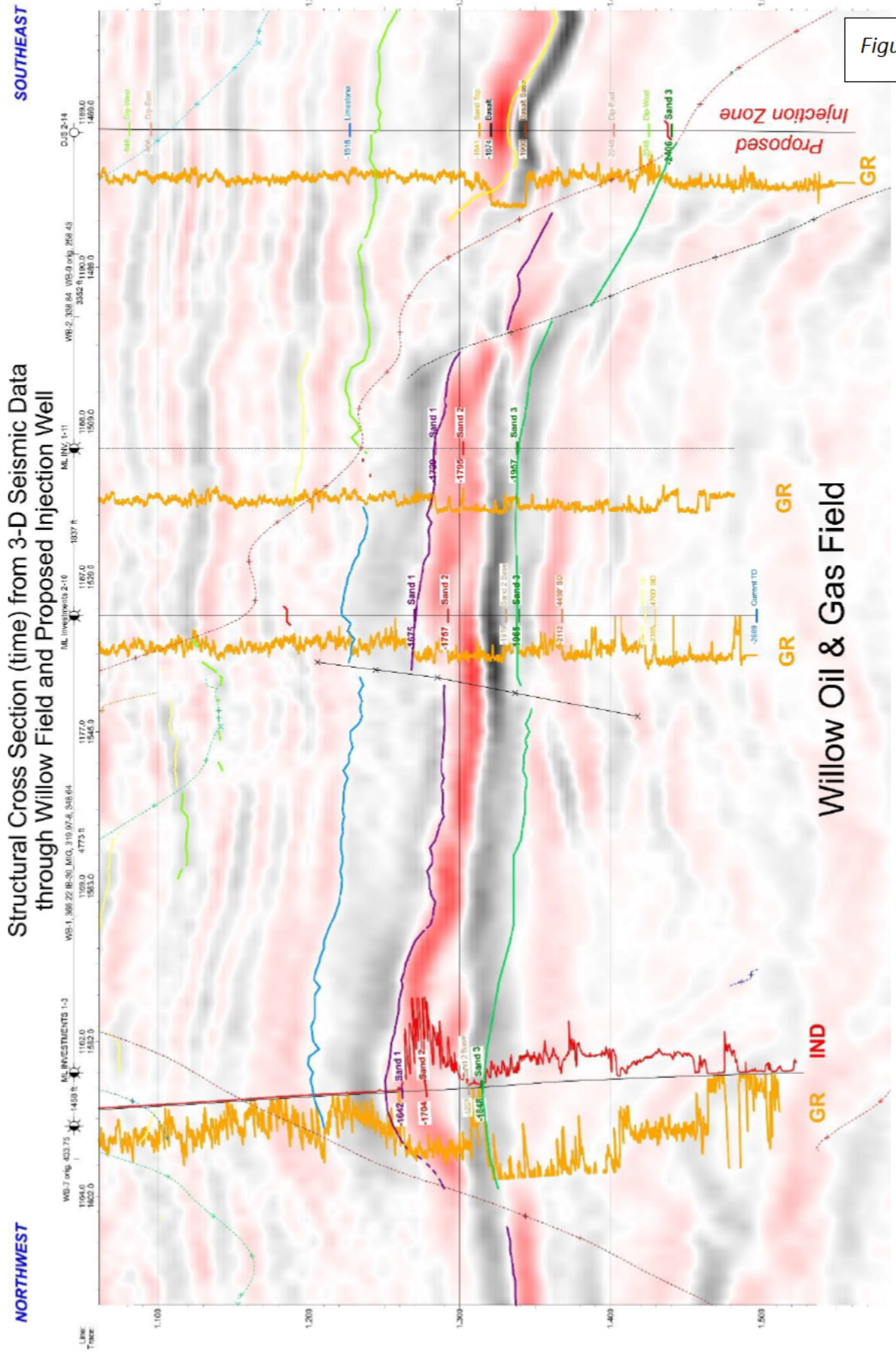

8N 4W
C
C'
LINE OF CROSS SECTION
LINE OF CROSS SECTION
-1642
-1786
-1771
-1836
-1875
-1729
-1980
STRUCTURE MAP
Top of Willow Sands
Depth in feet below sea level
Contour Interval : 50'
FEET
0 1000 2000 3000 4000 5000
D.M. Smith 2019
X/Y: Feet
875000
870000
865000
230000
225000
220000

Figure G- 11-A


C'
SOUTHEAST
Structural Cross Section (time) from 3-D Seismic Data
through Willow Field and Proposed Injection Well
NORTHWEST
C
GR
IND
Sand 1
Sand 2
Sand 3
Limestone
Basalt
Current TD
D.M. Smith 2019

C'

SOUTHEAST



NORTHWEST

C

Figure G- 11-B

D.M. Smith 2019

Summary Evidence for Sealing Nature of the Faults.

1. As discussed previously, the overlying clays and ash beds documented in all of the area wells provide an excellent confining layer.
2. Each productive fault block is essentially an upthrown 3-way structural trap against a fault. For oil and gas to be trapped here in large commercial accumulations, the faults must by definition be sealing, and not open to shallower zones. The plastic, malleable character of the overlying *and adjacent* Chalk Hills clays and ash beds is here proven to be a viable and competent seal.
3. The small faults present in the area are syndepositional (movement in a dip direction coincident with deposition of the sediment). They typically have small dip offset (50' – 200') and none have lateral displacement. This character means the movement was early, and likely has ceased. The faults are also relatively short in length (typically a few thousand feet or less), also suggesting only early dip displacement.
4. Comparing pressure behavior in Fault block A vs Fault block B (**Figures G- 12 and G-13**):
   - Pressure behavior between fault block A and fault block B suggest that the two fault blocks are isolated from each other and are not in communication (see G-11, Pressure vs Time plot)
   - ML 1-11 and ML 2-10 both are in fault block B and were brought on line in the same month (Aug 2015).
   - The ML 3-10 is situated in Fault Block A, adjacent to Fault Block B. The ML 2-10 and ML 1-11 were on production for approx. 28 months before the ML 3-10 was opened to production.
   - Note that the ML 3-10 Initial SITP was 1600 psig prior to opening well to production which indicates the reservoir was under virgin pressure conditions. Virgin reservoir pressure gradients run approx. 0.43 psi / ft
   - If these two fault blocks were in communication, the ML 3-10 well would have been partially pressure depleted and a much lower initial SITP would've been observed.

Comparing Fault block A vs Fault block B –

Figure G- 12

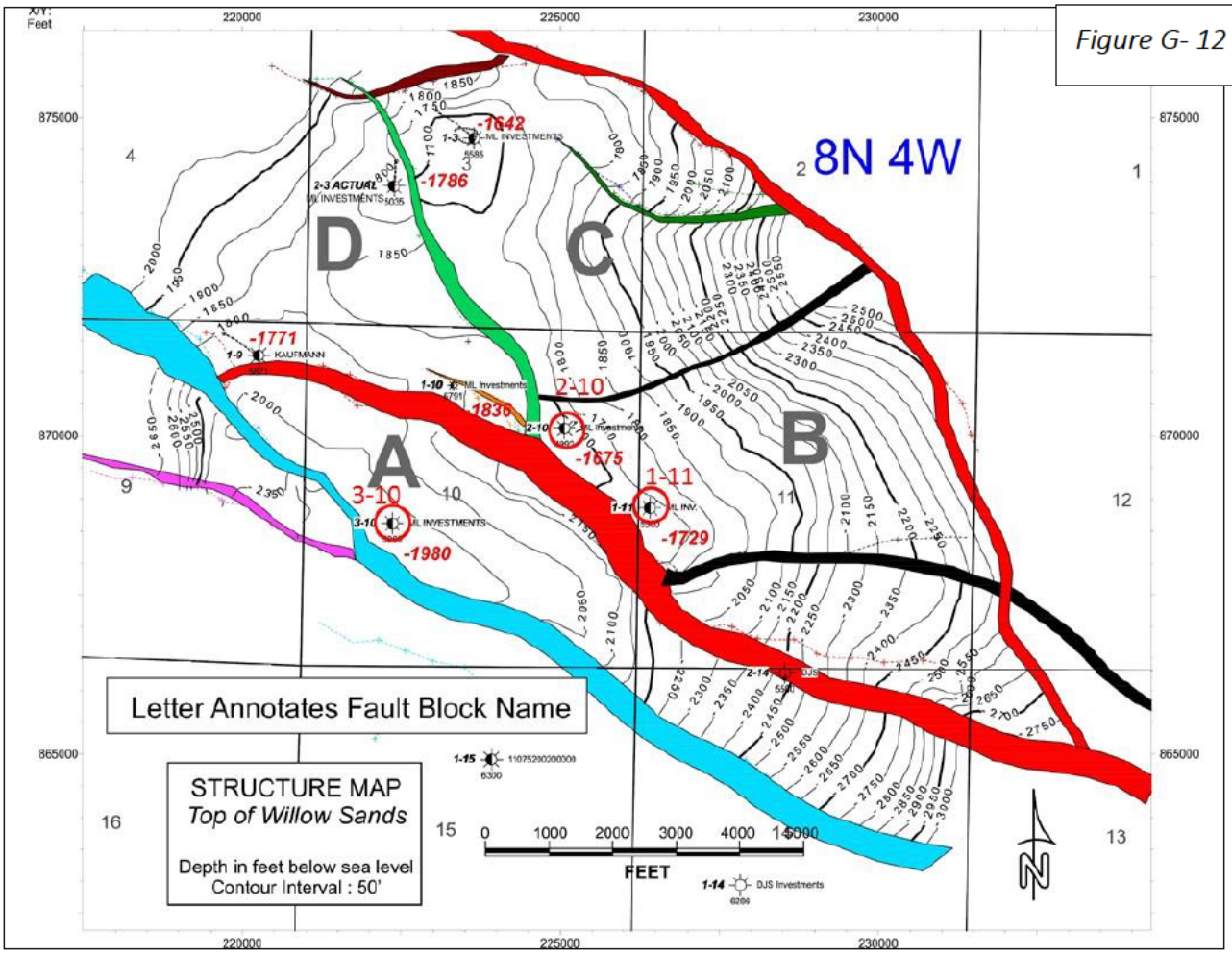
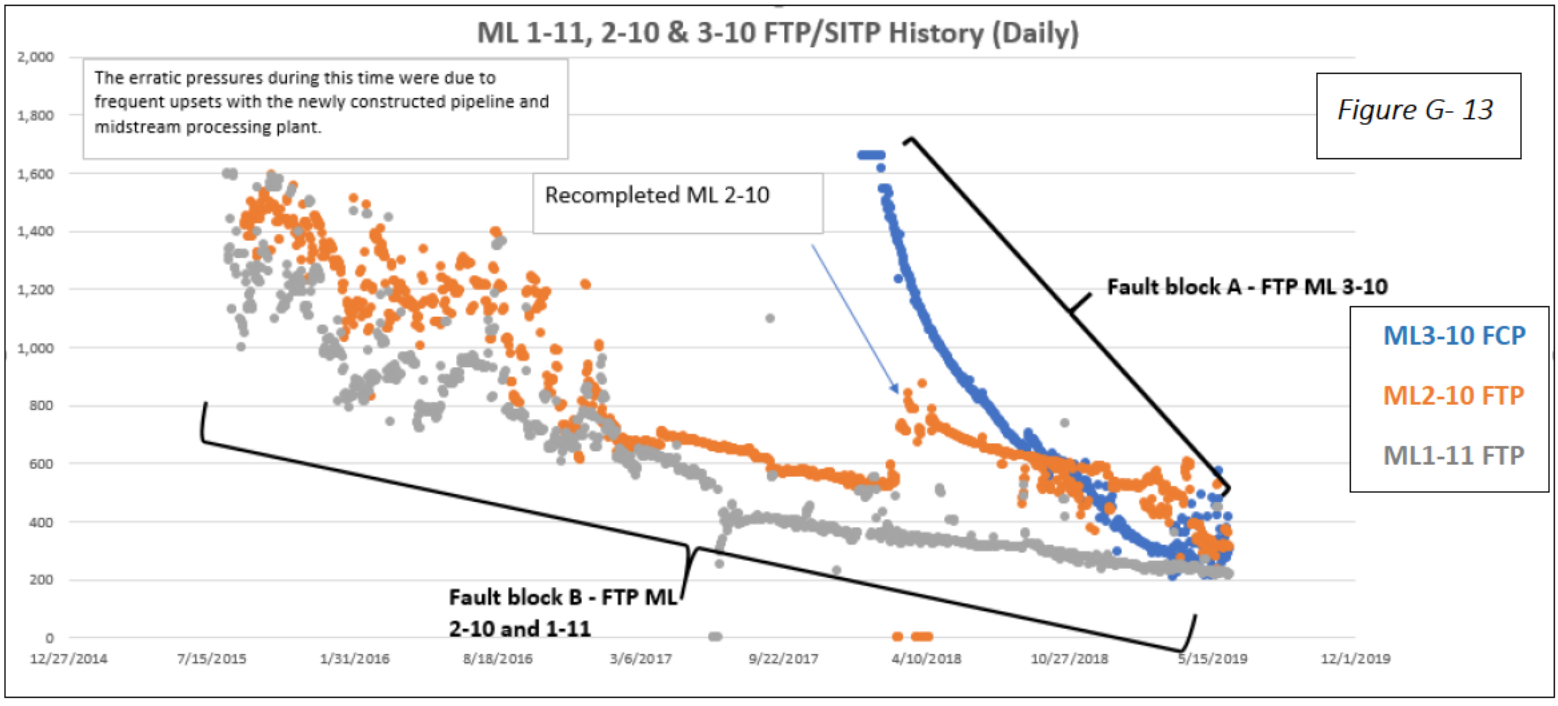


Figure G- 13



AM Idaho DJS #2-14 Proposed Disposal Well Geologic Setting

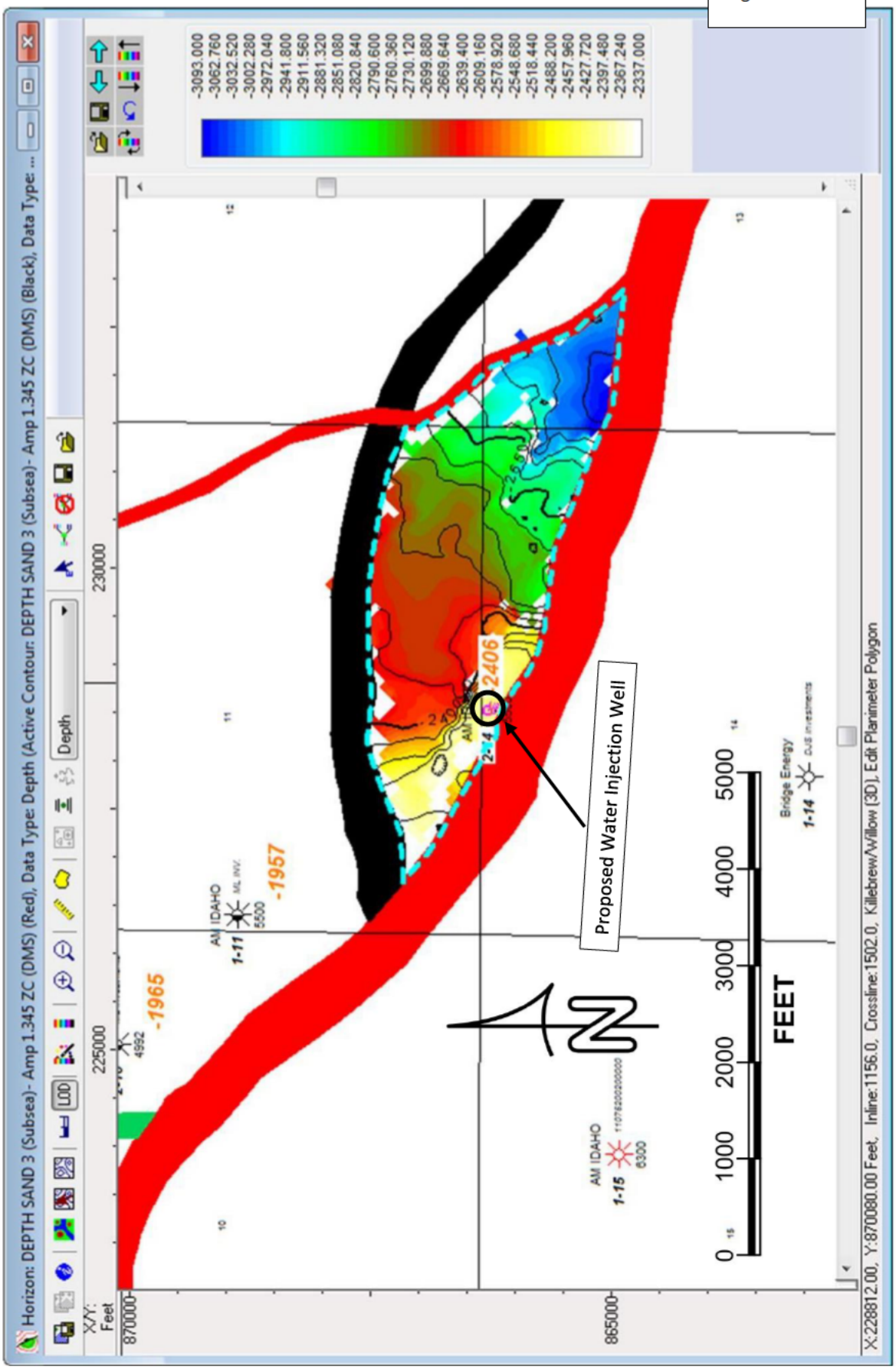
Township: 8 North - Range: 4 West - Section 14

Payette County , Idaho

The following structure and Isopach maps were created from interpreting proprietary 3-D seismic data in conjunction with subsurface well control. Subsurface to seismic ties were done by making synthetic seismograms and verifying ties with seismic modelling. Due to the subsurface presence of basalts (very high acoustic impedance), the seismic to subsurface ties are excellent. The quality of the seismic data is very good to excellent, lending strong confidence to the interpretations Presented herein.

Figure G- 14

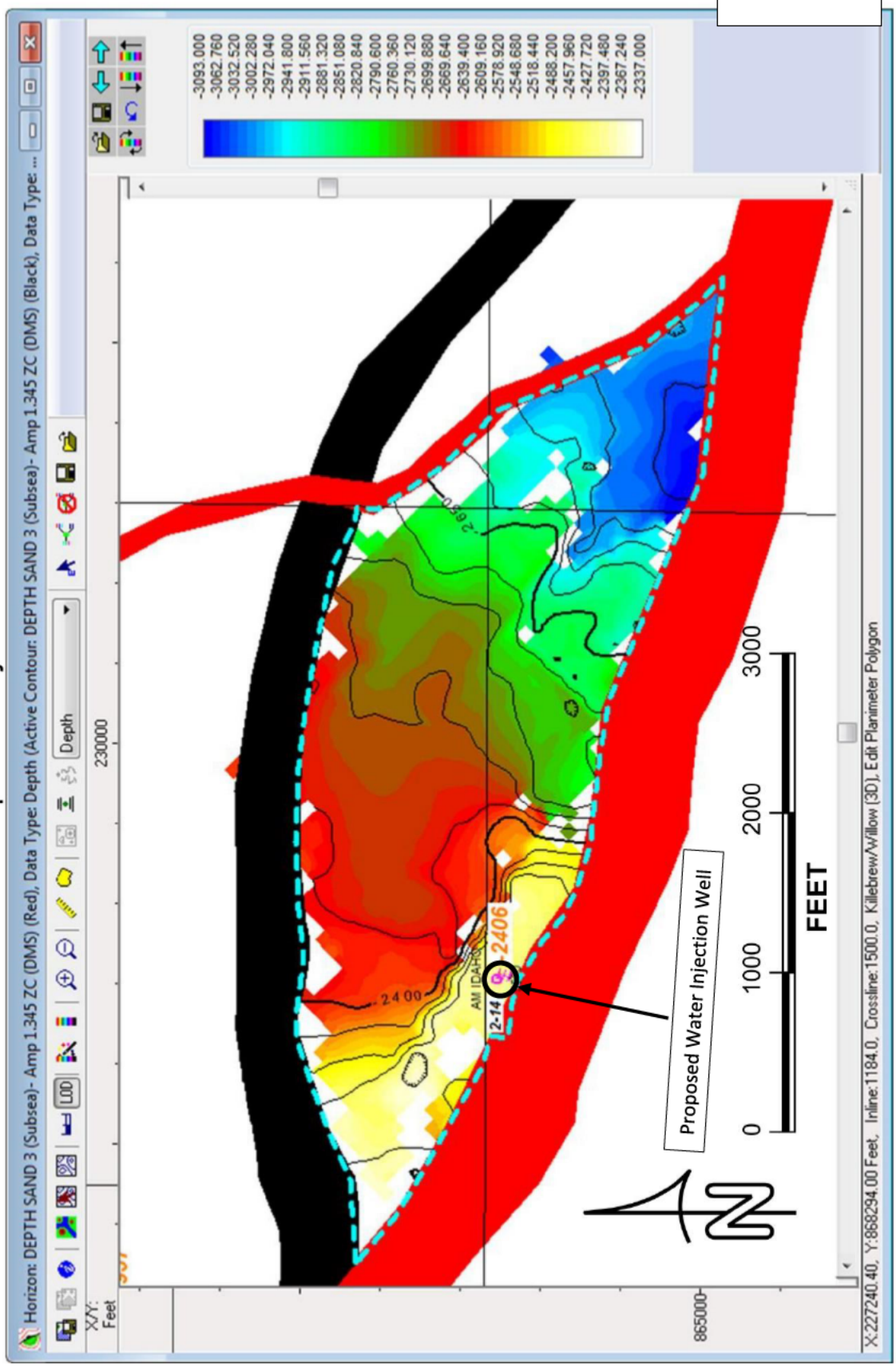
Structure Map (Subsea): Top Willow Sand 3
Proposed Injection Zone



DMS 9/2017

Figure G- 15

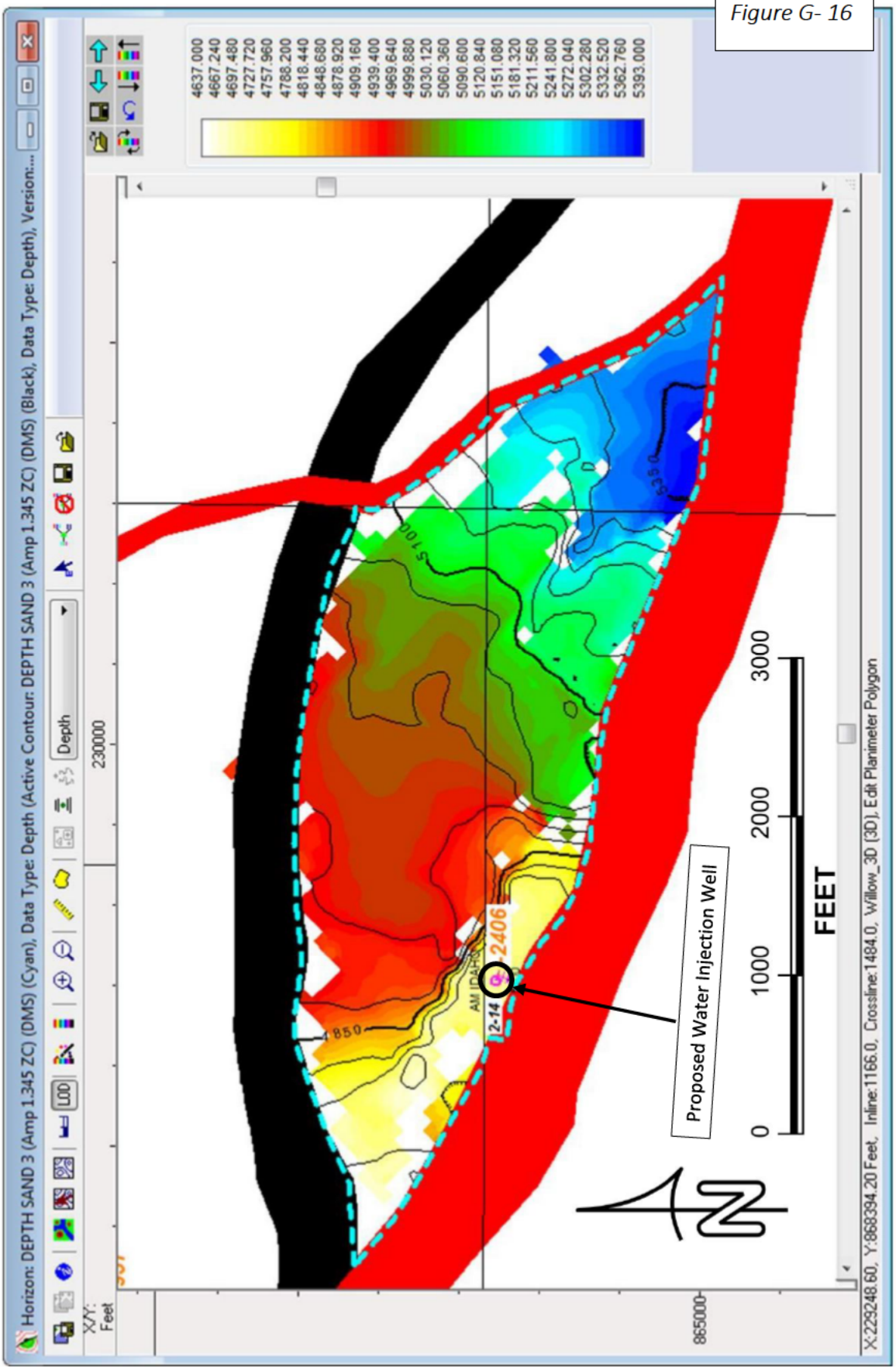
Structure Map (Subsea): Top Willow Sand 3
Proposed Injection Zone



DMS 9/2017

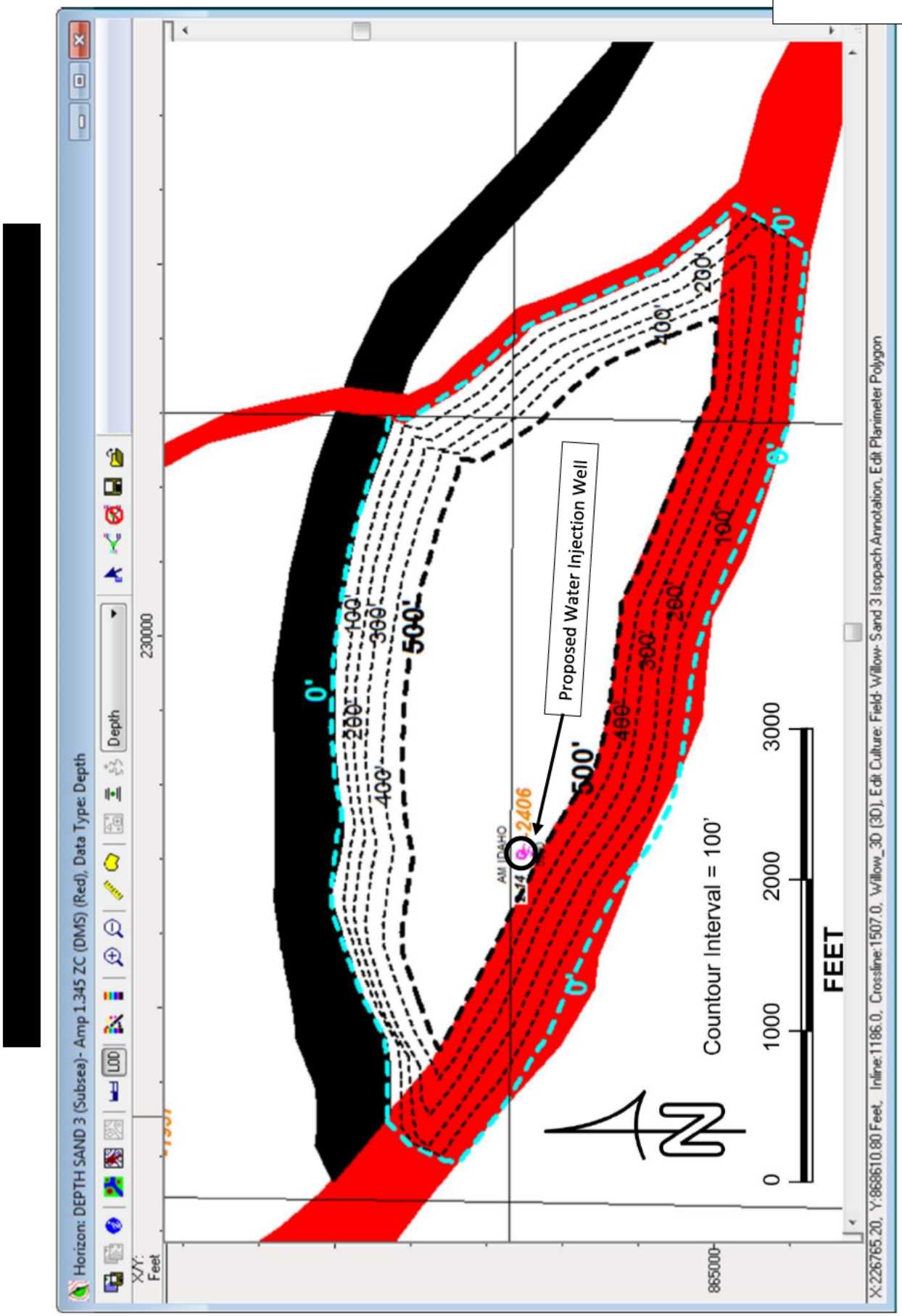
Structure Map (Below Ground Level Datum of 2300' ASL):
Top Willow Sand 3 - Proposed Injection Zone

Figure G- 16



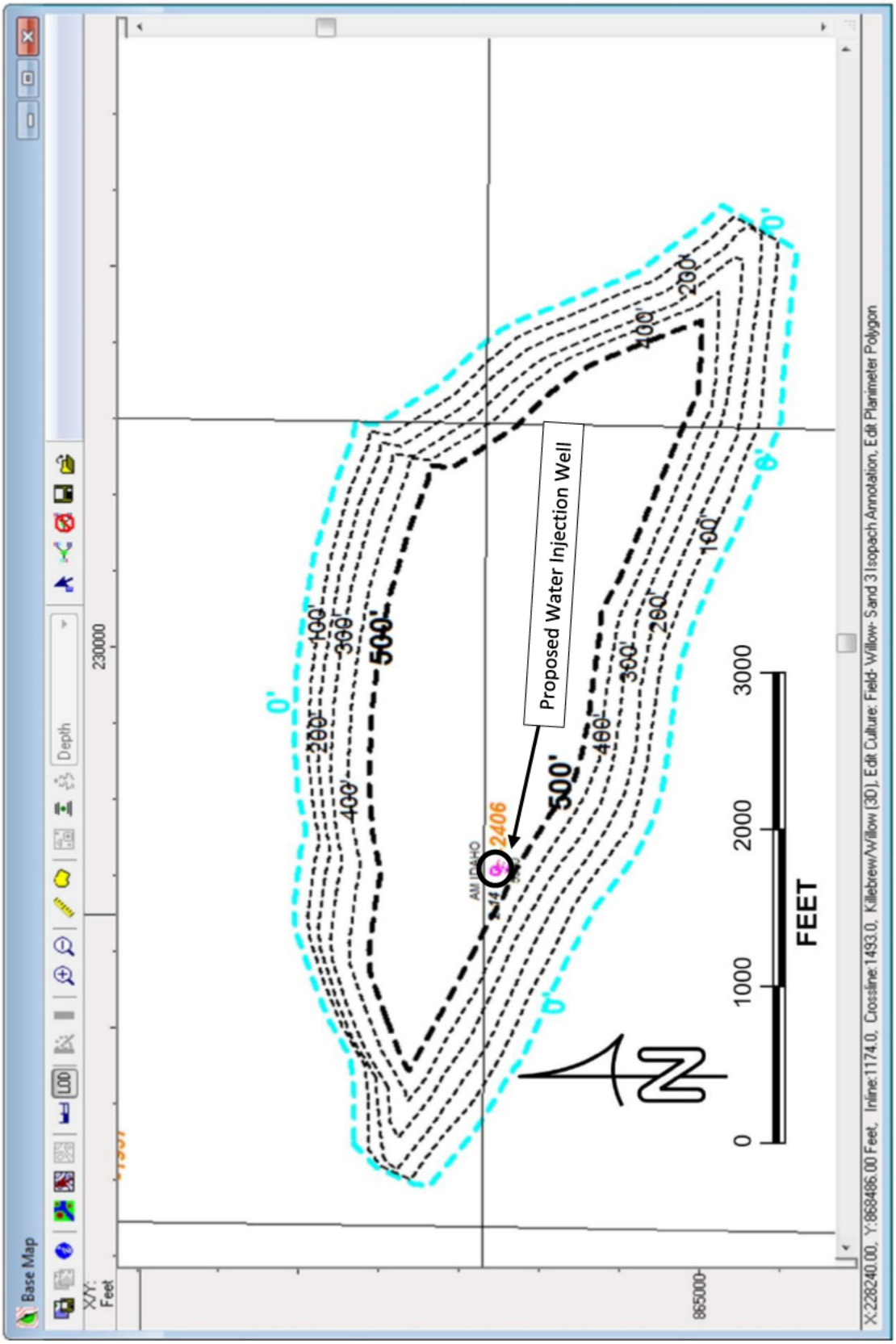
DMS 9/2017

Figure G- 17



DMS 9/2017

Figure G- 18



DMS 9/2017

ATTACHMENT H: Operating Data

H. Operating Data – The expected average daily rate and volume is 1000 barrels per day (BPD) / 1000 barrels (BBL). The maximum daily rate and volume is expected to be 2600 BWPD / 2600 BBL, based on a mechanistic hydraulic model of the wellbore tubulars and the reservoir characteristics.

The average and maximum surface injection pressures are estimated to be 199 (psig) and 628 psig, respectively, based on the hydraulic model.

The fracture pressure in the lower Chalk Hills Formation @5390' has been estimated at 3214 psi, based on a 12 ppg equivalent fluid density. A leak off test will be run during the completion procedure to verify the fracture pressure of the confining zone as necessary. Dipole sonic data may become available prior to the completion construction procedure, and will be utilized instead of performing a leak off test to provide the capability to calculate Poisson's ratio and the associate frac gradients in the injection and confining zones. In addition, a step-rate test will be run prior to injection operations to determine actual fracture pressure in the injection zone. Injection operations will be controlled to always provide at least 50 psi below that pressure.

The tubing / casing annulus will be filled with 8.8 lb/gallon potassium chloride water, supplemented with an appropriate corrosion inhibitor, biocide, and oxygen scavenger chemical additive package. (See appendix H for the MSDS's).

A step-rate test will be performed after initial commissioning of the injection facilities and well. The step rate test will allow the reservoir parting pressure to be determined and subsequent injection rates will be limited to maintain injection pressures at least 50 psi below this pressure.

The source of the injection fluid is produced water, associated with the oil and gas production operations of wells operated by AM Idaho LLC in the surrounding area. An analysis of the produced water is attached (see appendix S for full analyses). The produced water in this area is very low salinity and low TDS since the geologic sedimentary history is that of a lacustrine nature.

A calculation of the expected injection reservoir capacity was performed. This calculation assumes a confined reservoir pore space as defined by the isopach of the injection zone in a fault block bounded on 3 sides by faults (see Attachment G for details). The bulk volume is calculated by determining the area of each isopach interval and using the average of the areas to calculate the total bulk injection reservoir volume. A porosity of 23% is estimated from open hole wireline logs for the injection interval. Water saturation is estimated at 80%, with a complementary 20% gas saturation. This is based on the swab test of the 5380' – 5390' perforations, where gas blows were experienced and a water sample showed the presence of Benzene and other VOC's naturally associated with water associated with hydrocarbon reservoirs. The average net reservoir to bulk thickness ratio is estimated at 90% from a review of the mud log for this interval. The pore space is estimated to contain 152 million reservoir barrels. Under confined injection, the water, gas, and pore space will compress and expand respectively to allow for water influx as pore pressure increases. The maximum allowable pressure is defined by staying 10% below fracture pressure. Fracture pressure is estimated to be equivalent to a 12 lb/gallon gradient (3214 psi at 5150'). Note that the actual parting pressure will be well defined upon completion of the well by the execution of a step rate test. The original pressure is estimated at a pressure equal to an 8.6 lb/gallon equivalent pressure gradient (2276 psi at 5150'). The maximum allowable pressure used in the calculation of Injection Zone Capacity is 90% of the fracture pressure (90% of 3214 = 2892 psi). This provides for an allowable increase in the reservoir pressure of 616 psi (2892-2276). Water, gas, and pore space compressibility's are estimated using standard oil and gas industry correlations. Based on the original reservoir volume, along with the allowable pressure increase and the sum of the compressibilities, it is estimated that a total of 7,773 thousand reservoir barrels can be injected into this space before the pressure limit is reached. This equates to 7,368 thousand stock tank barrels based on a water reservoir volume factor of 1.055 RB/STB. Stock tank barrels are measured at atmospheric pressure and 60 degrees F. See Figure H-1 for volumetric calculations.

Calculation of Confined Injection Zone Capacity

DJS Properties #2-14 Injection Zone

Calculation of Reservoir Volumes:

Porosity	0.23	fraction	from well log
Sw	0.80	fraction	water saturation - evidence of gas in swab testing and water analysis
Sg	0.20	fraction	gas saturation - evidence of gas in zone from swab testing - residual gas
Gross Volume	94,700	acre-ft	from planimetry calculations below
Net/Gross Ratio	0.90	fraction	from well logs
Pore Volume	19,603	acre-ft	

Reservoir Isopach Area Planimeter Readings:

CONTOUR LINE VALUE	AREA > (acres)	RATIO OF AREAS	DELTA CONTOUR (ft)	DELTA VOLUME (acre-ft)	
0	269.00				
100	234.00	0.8699	100	25,150.0	
200	205.00	0.8761	100	21,950.0	
300	173.00	0.8439	100	18,900.0	
400	144.00	0.8324	100	15,850.0	
500	113.00	0.7847	100	12,850.0	
		TOTAL ==>		94,700.0	acre-ft - gross bulk reservoir volume

Injection Zone Capacity

Item	Value	Units	Comments - notes
Datum Depth:	5150	ft, BGL	average depth of injection zone
Average Temperature	251	deg F	ML Investments 1-3 production log
Initial Pressure:	2276	psi	8.6 ppg equivalent pore pressure at datum depth
Fracture Pressure:	3214	psi	12 ppg equivalent pore pressure at datum depth
Maximum Allowable Pressure	2892	psi	90% of fracture pressure
Maximum Pressure Increase (dP)	616	psi	maximum allowable pressure less initial pressure
Average Pressure	2584	psi	average of initial pressure and maximum allowable pressure
Water Salinity	750	ppm Cl	estimated average
Water Compressibility	3.48E-06	1/psi	Osif's Correlation
Gas Compressibility	3.87E-04	1/psi	Meehan et al, Gas gravity = 0.65 from ML Investments 1-10 Well
Rock pore volume compressibility	3.50E-06	1/PSI	Hall's Correlation
Reservoir Water Volume Initial	15,682	acre-ft	Pore Volume * Sw
Reservoir Water Volume Initial	121,663,439	RBbls	Pore Volume * Sw
Reservoir Water Volume Compression	261,022	RBbls	dP * water compressibility* initial water volume
Reservoir Gas Space Volume Initial	3,921	acre-ft	Pore Volume * Sg
Reservoir Gas Space Volume Initial	30,415,860	RBbls	Pore Volume * Sg
Gas Pore Space Compression	7,250,191	RBbls	dP * gas compressibility * initial gas volume
Pore Space Volume Increase	262,281	Rbbls	dP * pore space compressibility
Total Pore Space volume increase	7,773,494	RBbls	sum of water, gas, and pore space compression
Bw (water formation volume factor):	1.055	RBbl/STBbl	McCain's Correlation
Total Stock Tank Barrels Capacity	**7,368,241**	**STBbls**	adjust to surface conditions by dividing by water formation volume factor (Bw)

ATTACHMENT I: Formation Testing Program

I. **FORMATION TESTING PROGRAM –** A step rate test will be run at the time of initial completion to determine the actual parting pressure of the injection interval after the packers and tubing is installed. The water used in this test will be from the same source as the proposed source water. Surface injection pressure and injection rates will be measured during the step rate test. The determination of bottom hole parting pressure will be indicated by a departure in the injectivity ratio (dRate/dPressure) when the parting pressure is exceeded. The pressure defined by the intersection of the slopes of the injectivity data below and above parting pressure will define the surface maximum injection pressure. All injection operations will be held to 50 psi or more below this pressure to assure that fracturing of the injection interval does not occur. Bottom hole pressures will be calculated based on the density of the fluid being injected, along with surface pressure measurements.

ATTACHMENT J: Stimulation Program

J. STIMULATION PROGRAM **–** No stimulation program is expected to be needed. The sandstone in this area has good permeability and the unstimulated injectivity should be sufficient.

ATTACHMENT K: Injection Procedures

INJECTION PROCEDURES – Individual monitoring of the DJS Properties #2-14 is planned. Gauges will be installed at the wellsite, and a flow meter will be installed at the pump station. Casing pressure will be maintained at 0 psig. If any pressure is noted on the annulus between the tubing and the production casing, injection will immediately be halted. Injection will not be resumed until the source of the pressure has been identified and repaired. Injection pressure at the wellhead on the tubing will be maintained 50 psi below parting pressure. An initial step-rate test will be performed to determine parting pressure to beginning injection operation. Produced water will be gathered into stock tanks and through additional settling and filtration vessels, as necessary to assure clean water is pumped downhole. A polish filter will be installed at the wellhead to catch any solids that make their way to the wellhead. An injection pump will be located near the stock tanks to pressurize the water and transport the water via flowline to the wellhead. A pressure relief valve will be installed on the pump to prevent excessive pressure from being placed on the flowline. This relief valve will be piped back to the source tanks or to the intake of the pump. Source water will be provided by the producing wells. The flowline will be buried below grade to avoid freezing issues. The portion of the flowline above grade will have insulation and heat tracing to avoid freezing during winter operations. The flowline easement and wellhead will be visually inspected daily (within reason, due to considerations of weather and other force majeure) by field operating personnel.

ATTACHMENT L: Construction Procedures

CONSTRUCTION PROCEDURES –

Historical:

Spud well 9/11/2014. Surface hole was drilled with 12 ¼" bit to 1093'. 9 5/8" 40 lb/ft K-55 LTC casing was then set at 1082' and was cemented back to surface. An 8.75" hole was drilled to 5,500' and production casing was then run and cemented (7" 26 lb/ft J-55 LTC casing with bow spring centralizers). A top down cement job was then performed on the 7" casing, to provide cement coverage between the production casing and the surface casing down below the shoe of the surface casing. The prospective hydrocarbon intervals were then tested by perforating and flow/swab tested each of 5 intervals between 5390' and 4306'. All tested non-commercial. The first zone at 5380-5390' did have good gas blows during swabbing. Cement retainers or bridge plugs were set between intervals during the testing operations which proceeded from the bottom to the top interval, and was also placed above last interval after testing. Testing was completed by 11/3/2014. See attached wellbore diagram.

Planned Well Construction Procedure for Injection:

1. Move in workover rig.
2. Pressure test casing above bridge plug at 4,294'
3. Drill out plugs and retainers to below float collar to 5,450'. If dipole sonic data is not available, run leak-off test prior in the Confining Zone to verify fracture gradient in the Confining Zone.
4. Add perforations in interval 5390 – 5410'.
5. Run tubing, packer and isolation packer to 4860' and set upper packer at 4200'. (see attached wellbore diagram).
6. Install wellhead assembly.
7. Run step rate test with actual produced water to determine parting pressure and injectivity.
8. Connect gauges and filter pod, flowline, pump, and commission injection system.

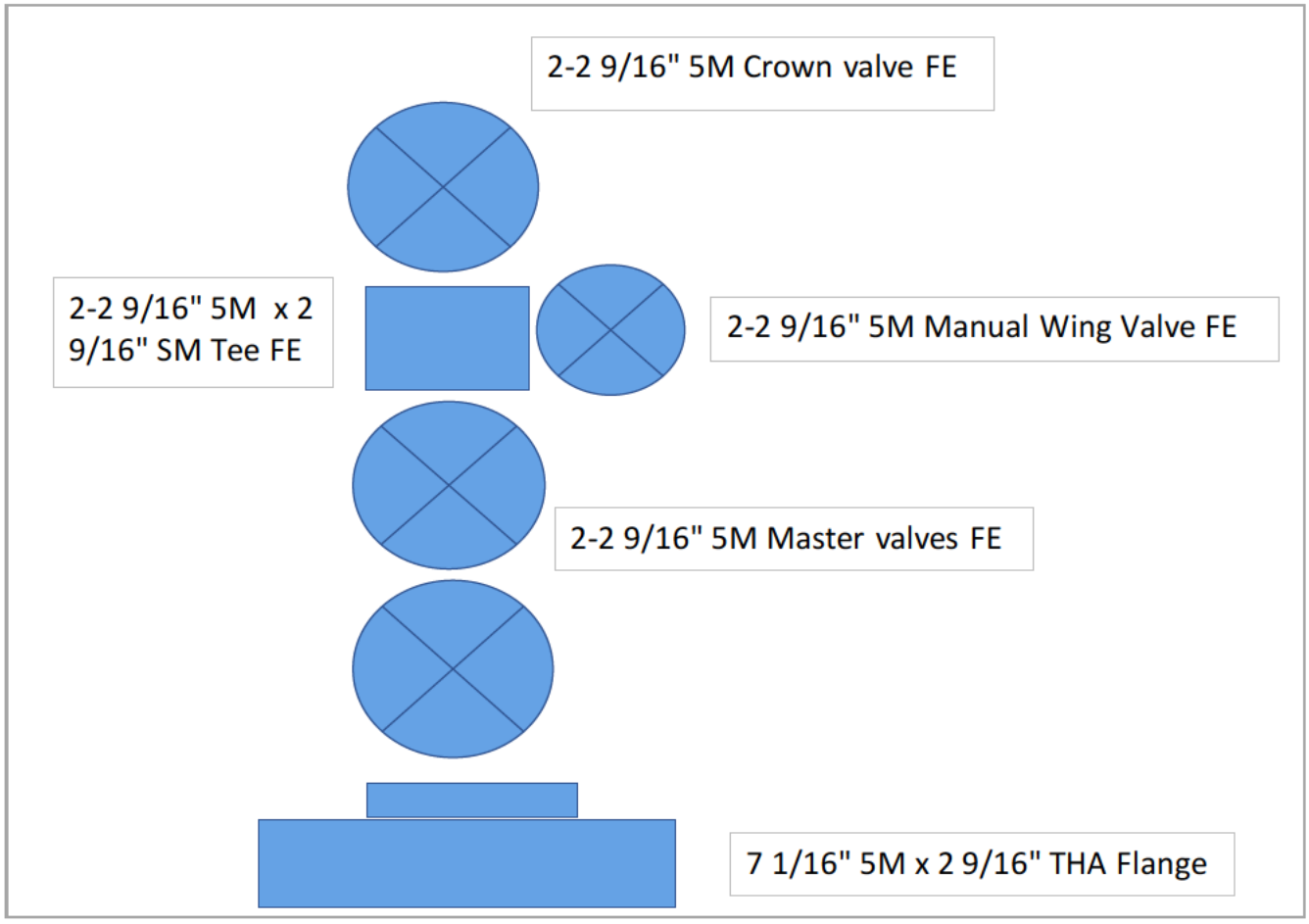
Planned Facilities Construction:

Little Willow Production Facility – Install pump, metering equipment and valving.

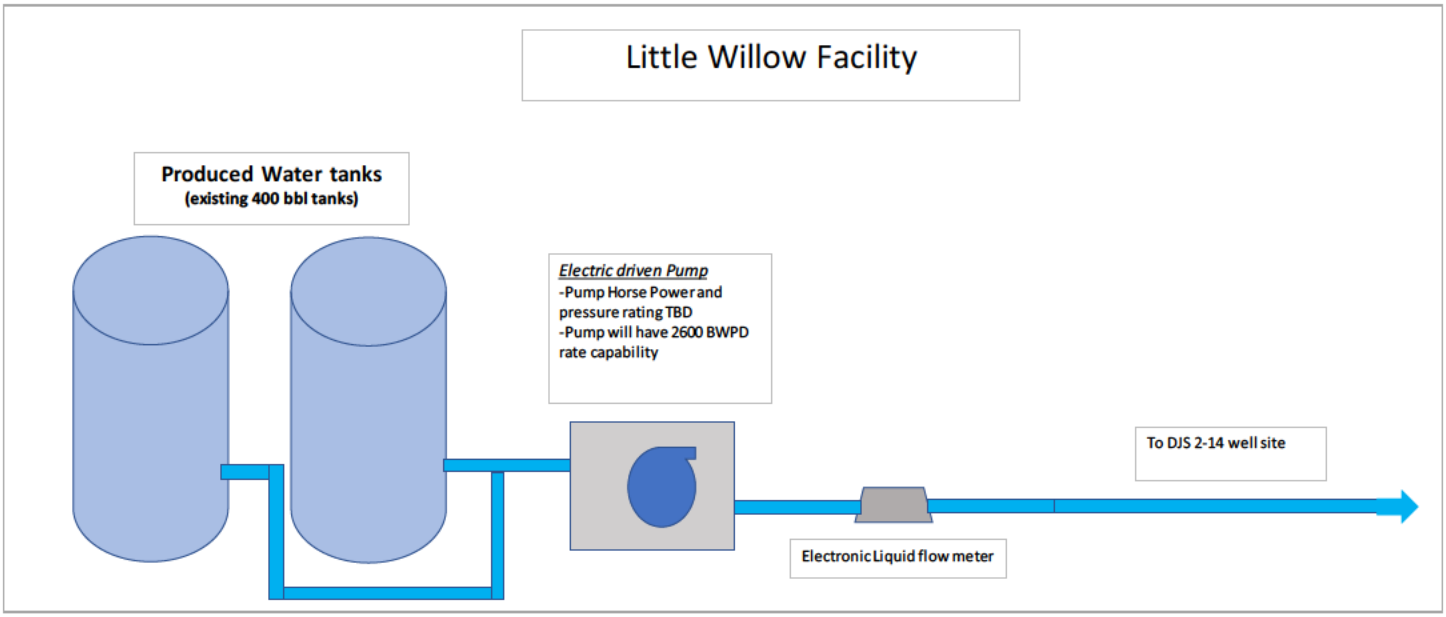
DJS 2-14 well site – Install new wellhead and filter unit.

ATTACHMENT M: Construction Details

M-1 Proposed Wellhead Configuration for the Water Disposal Well

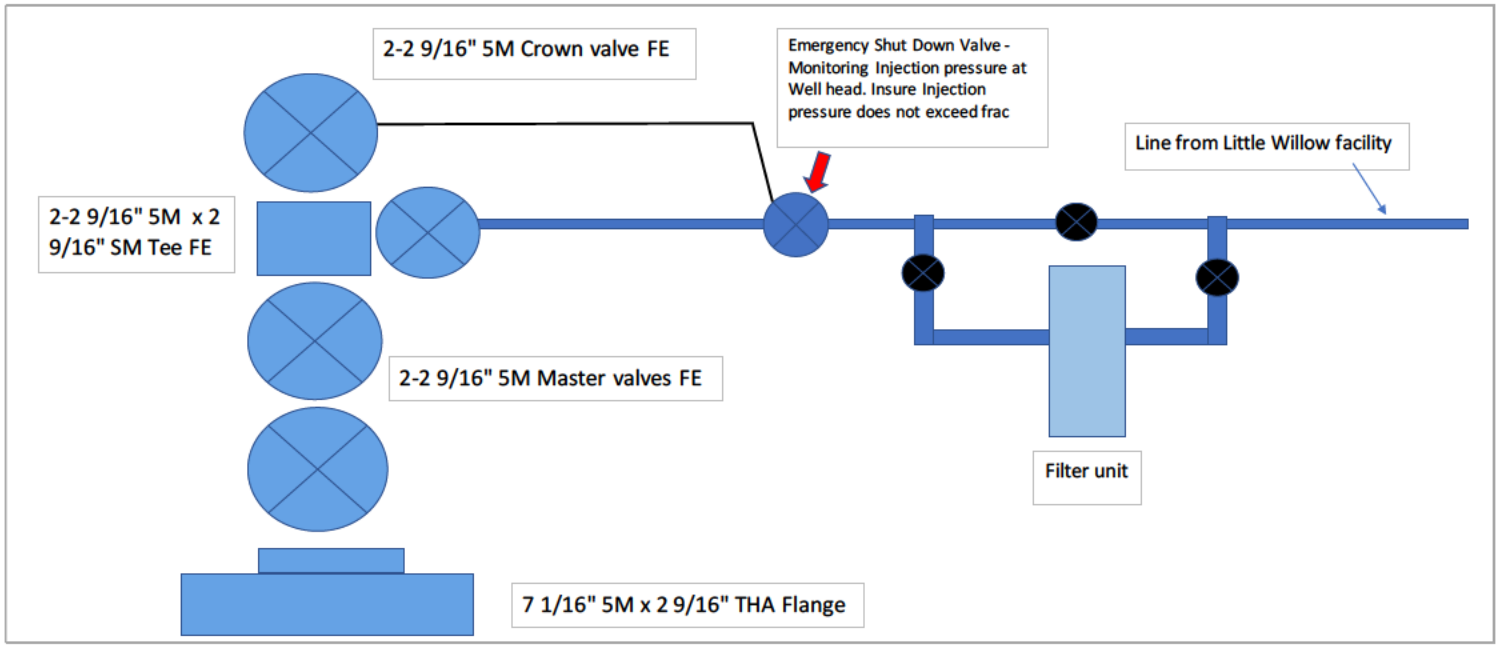


M-2 Proposed Injection Equipment to be installed at Little Willow Production Facility.



- Process Summary – Little Willow Facility: Plan to install an electric driven pump capable of discharging 2600 BWPD (HP and pressure rating – TBD).
- Produced water will be collected into the water stock tanks (current operations) and will feed the suction side of the pump.
- Water will be energized via the pump and then will move through and electronic flow meter before being sent to the DJS 2-14 well site.

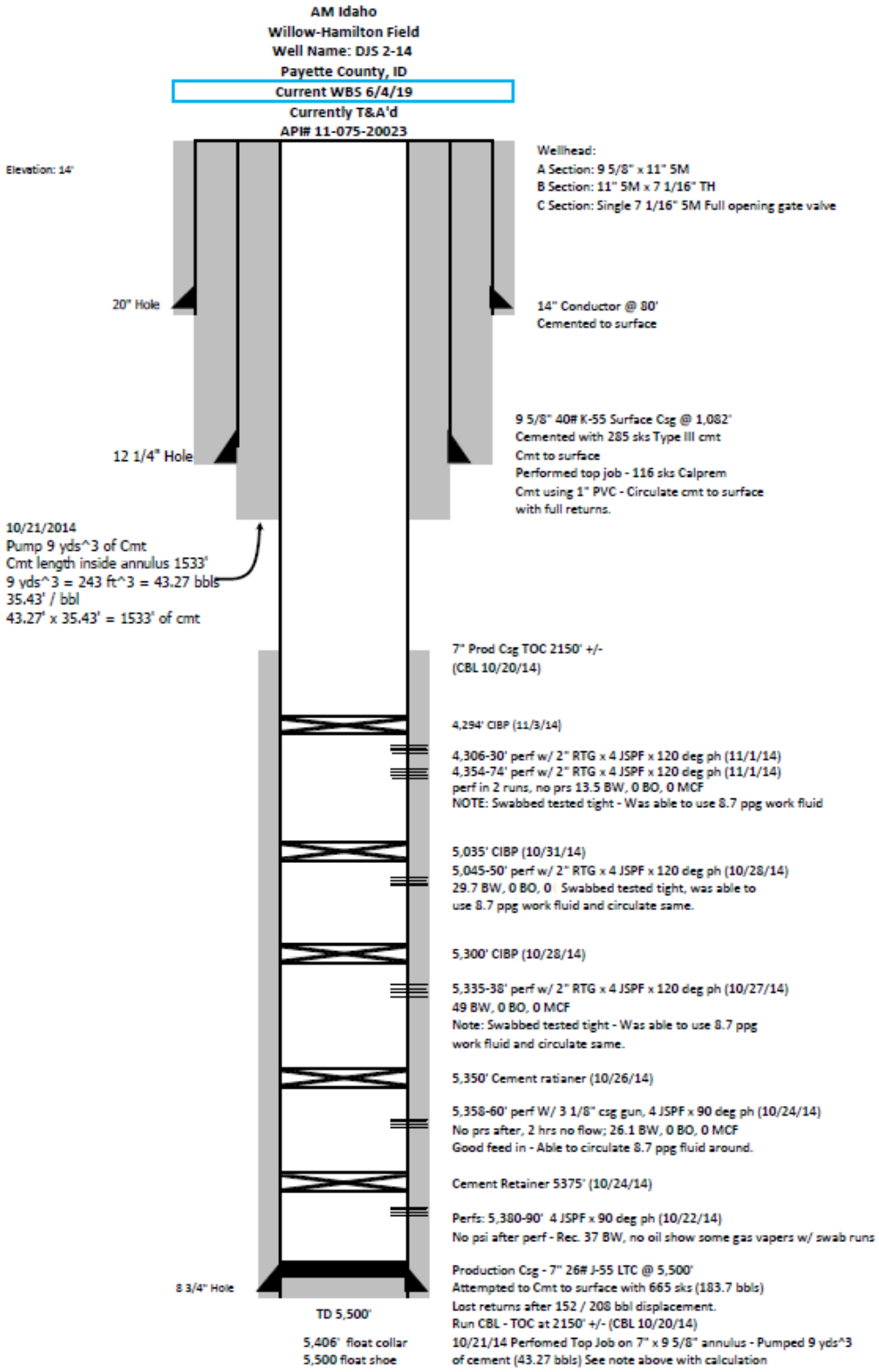
M-3 Proposed Injection Well Site Equipment Layout



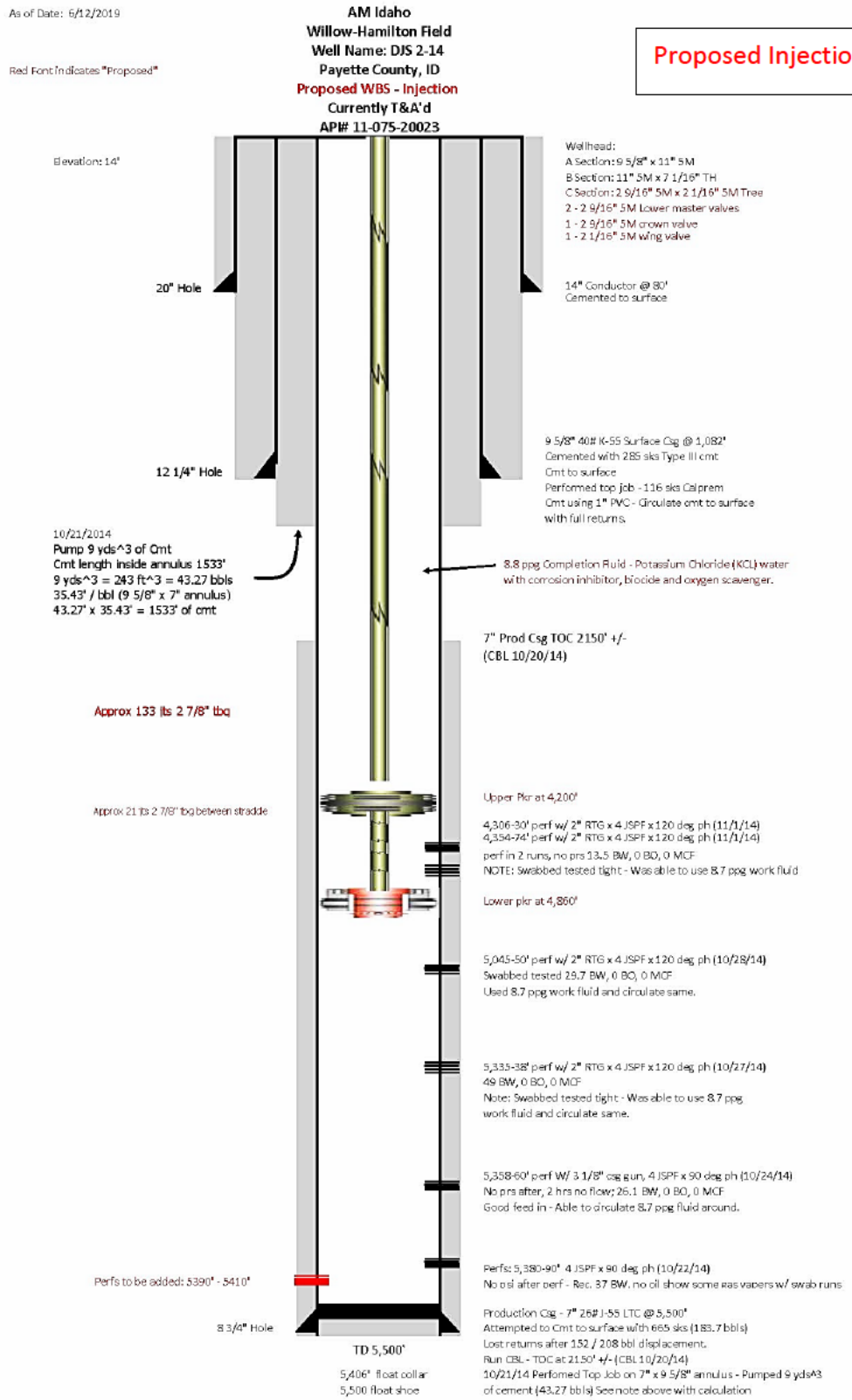
- Process Summary – Water will be transported from the Little Willow Production Facility to the DJS 2-14 well site where it will be filtered before going down hole.
- Additionally, and Emergency Shut Down Valve (ESD) will be installed upstream of the wellhead to ensure that the injection pressure does not exceed the frac pressure during injection service.

CONSTRUCTION DETAILS – See the following pages for wellbore schematics.

Current Wellbore



M-5 Proposed Wellbore Diagram



ATTACHMENT O: Plans for Well Failures

PLANS FOR WELL FAILURES -- The potential areas of concern for this type well are three points: 1) packer to casing seal, 2) tubing connections or tubing body leak, or 3) tubing hanger seals. For any of these components a leak will be indicated by the existence of pressure on the tubing / casing annulus pressure gauge. These type of leaks will be contained within the wellbore envelope. If pressure is observed on the casing gauge, injection operations will immediately cease. The wellhead will be isolated by closing in all wellhead valves and the pump and flowline valves will be closed. The tubing hanger seals will be inspected using a wellhead service company technician who can pressure test the seals for leaks. After this testing is done, a workover rig will be utilized to repair the leaking seals or to pull the tubing and packer so that they can be inspected for leaks and replaced as necessary. Injection will not be reinstated until the leak is repaired and the annulus is pressure tested to verify integrity of the injection components.

Mechanical integrity tests will be run periodically according to permit requirements by applying pressure on the annulus between the production casing and the tubing. This test is designed to detect any production casing weakness. If any leaks are noted, injection operations will not resume until the leak is located and repaired.

ATTACHMENT Q: Plugging and Abandonment Plan

EPA – UNDERGROUND INJECTION CONTROL PERMIT APPLICATION ATTACHMENTS

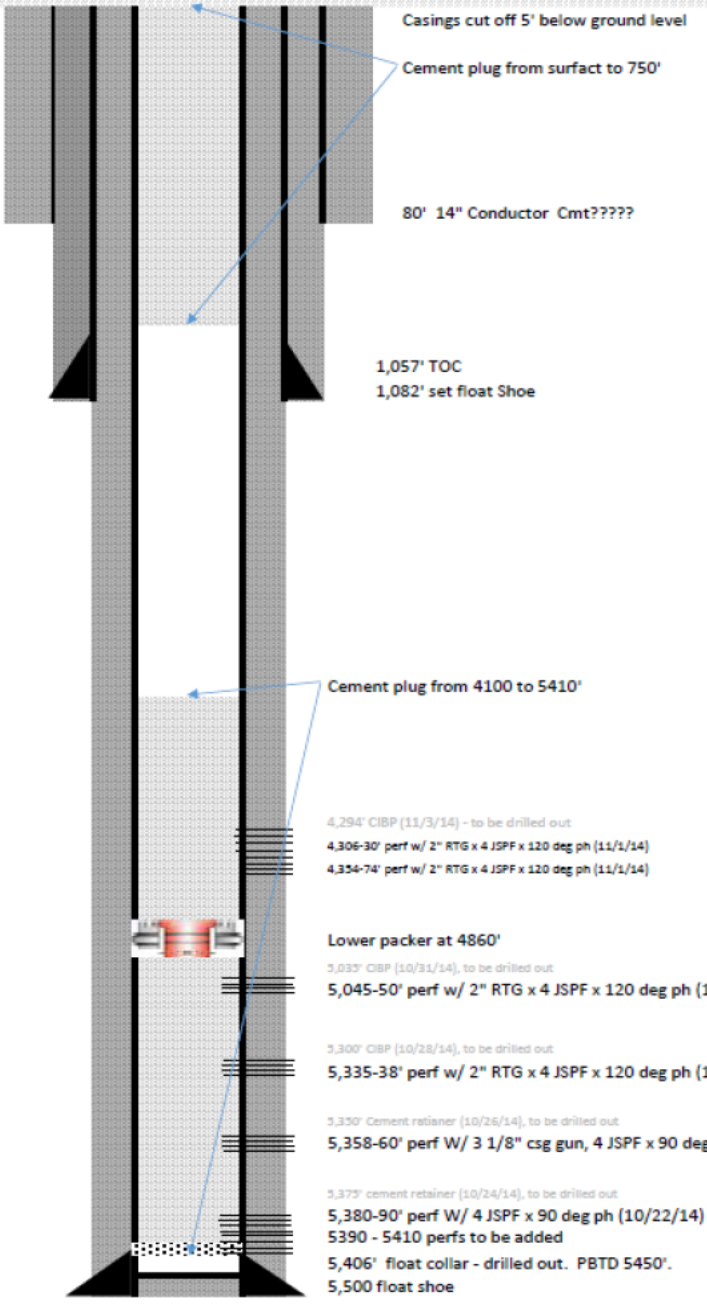
PLUGGING AND ABANDONMENT PLAN – See proposed Post-Injection Plugging Configuration wellbore diagram and associated EPA Form 7520-14 which details the proposed plugging and abandonment plan for this well.

Q-1 Proposed post-injection plug and abandon wellbore diagram

Well name: DJS 2-14
Willow Field - Payett County, ID
Proposed post-injection plugging configuration
Spud 9/12/2014 T&A'd 11/3/2014

P&A Wellbore

GL Elevation above MSL: 2,488'



Casing & Cement

Conductor: 13 3/8 OD, @ 80'

Surface: 24 jts, 9-5/8" OD, 8.83 ID,40#, K-55 @ 1,082'

215 Sacks, (144 Bbls) Type III Cement + Slurrylite 50 Pps, 20% MS-500, 5% HW Gypsum, 5% Salt B.W.O.W., 0.75% TSFL-180, 0.25% CFL-300, 3.77 ft3/sk, 14.22 gal/sk, 10.4 ppg. Followed by 70 sacks, (17 Bbbls) Type III Cement + 5% Salt B.W.O.W., 1.36 ft3/sk, 6.42 gal/sk, 14.8 ppg.

Pump Top Job as Follows: Pump 116 sacks (23 Bbls) Calprem Cement + 2% Cacl2, 1.15 ft3/sk, 5 gal/sk, 15.8 ppg. Pump Top out cement @ 1.0 Bpm & 100 psi. (4 Bbls Cement to surface)

Production: 7" OD, 6.276" ID, J-55 @5.500'

Run 122 Total joints of 7", 26# J-55, LTC Casing as follows:

Float Shoe set @ 5,500', 2 Joints of Casing, Float collar set @ 5,406', 120 Joints of casing. Ran 64 Total 7" X 8 1/2" Bow Spring Centralizers, 1- Centralizer 10' above Shoe, 1- Centralizer on 1st casing Collar, 1- Centralizer 10' Below Float Collar, Centralizer on every Joint to Joint # 44 @ 3,509'. Then every 4th Joint to Joint #120 @ 80'. Centralizers Where Installed on collars on Casing Joints. Filled & circulated every 20 joints (No tight hole or problems Running Casing) (Tag with Joint #122 @ 5,500');

Cement as Follows: Pump 10 bbls of Diesel, 25 bbls of 10.0 Ppg Weighted Spacer @ 4.0 Bpm and 250 psi, Followed by 400 Sacks, (129 Bbls) TCI lite 61.6 Pps, Class G Cement, 25.9 Pps Flyash, 5.22 Pps gel, 1.82 ft3/sk, 9.72 gal/sk, 12.7 ppg. Pump Lead cement @ 3 Bpm & 340 psi. Followed by 265 Sacks, (54.7 Bbbls) Gas Seal Cement, Class G Cement, 3% Salt, 0.75% TSFL-180, 0.2% C-49, 1.16 ft3/sk, 4.9 gal/sk, 16.0 ppg. Pump Tail cement @ 3 Bpm & 239 psi. Displace with 208 Total Bbls as Follows: 152 Bbls 4% KCL Water @ 2 Bpm & 1300 Psi, (Lost Returns With 152 Bbls Displacement Away) (No Returns on last 56 Bbls) Pumped last 56 Bbls Displacement @ 1 Bpm & 3,700 Psi. (Bumped plug With 4,200 psi) Bleed off 2.5 Bbls, Check Floats, Floats Held Good. (No Spacer or Cement to Surface)

Pumped 9 cubic yards cement top down surface job.

5,500' TVD

Well Name & No.: DJS Properties 2-14	Field: Willow
County: Payette	State: Idaho
Total Depth (MD): 5,500'	(TVD) 5,500'
Date Completed: T&A on 11/3/2014	

Q-2 Proposed Plugging and Abandonment Plan

OMB No. 2040-0042 Approval Expires 12/31/2018

United States Environmental Protection Agency
Washington, DC 20460

PLUGGING AND ABANDONMENT PLAN

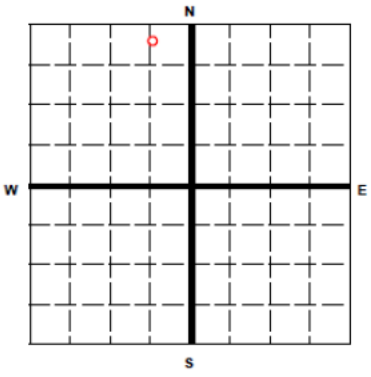
OMB No. 2040-0042 Approval Expires 12/31/2018

United States Environmental Protection Agency
Washington, DC 20460

PLUGGING AND ABANDONMENT PLAN

Name and Address of Facility	Name and Address of Owner/Operator
DJS Properties # 2-14	Alta Mesa Services, LP, 15021 Katy Fwy, St 400, Houston, TX 77094

Locate Well and Outline Unit on Section Plat - 640 Acres



State	County	Permit Number
Idaho	Payette	LU600120

Surface Location Description

NE 1/4 of NE 1/4 of NE 1/4 of N 1/4 of Section 14 Township 8N Range 4W

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location 95 ft. frm (N/S) N Line of quarter section and 2315 ft. from (E/W) W Line of quarter section.

TYPE OF AUTHORIZATION

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

Lease Name DJS Properties

WELL ACTIVITY

- [ ] CLASS I
- [x] CLASS II
  - [x] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Well Number 2-14

CASING AND TUBING RECORD AFTER PLUGGING

SIZE	WT (LB/FT)	TO BE PUT IN WELL (FT)	TO BE LEFT IN WELL (FT)	HOLE SIZE
7"	26	5500	5500	8.75"
9.625"	40	1082	1082	12.75
13.375"	61	120	120	17.5"

METHOD OF EMPLACEMENT OF CEMENT PLUGS

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [x] Other

CEMENTING TO PLUG AND ABANDON DATA:	PLUG #1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of Hole or Pipe in which Plug Will Be Placed (inche	7"	7"					
Depth to Bottom of Tubing or Drill Pipe (ft.	5410	750					
Sacks of Cement To Be Used (each plug)	TBD	TBD					
Slurry Volume To Be Pumped (cu. ft.)	282	162					
Calculated Top of Plug (ft.)	4100	0					
Measured Top of Plug (if tagged ft.)	N/A - future	N/A - future					
Slurry Wt. (Lb./Gal.)	TBD	TBD					
Type Cement or Other Material (Class III)	TBD	TBD					

LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)

From	To	From	To
4306	4330 (existing perfs)	5380	5390 (existing perfs)
4354	4374 (existing perfs)	5390	5410 (to be added for injection)
5045	5050 (existing perfs)		
5335	5360 (existing perfs)		

Estimated Cost to Plug Wells

TBD - cement type, volumes, density and type to be determined based on regulatory requirements and products in existence at time of plugging.

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibliity of fine and imprisonment. (Ref. 40 CFR 144.32)

Name and Official Title *(Please type or print)*	Signature	Date Signed

EPA Form 7520-14 (Rev. 12-11)

R-1 Idaho Oil and Gas Conservation Commission Bond

This bond replaces and supersedes Aspen American Insurance Co Bond No. SU46286 effective March 28, 2016.

IDAHO OIL AND GAS CONSERVATION COMMISSION

BOND

Bond No. 1138356

Known all men by these presents, that we: Alta Mesa Services, LP of the County of: Harris in the state of: Texas as principal, and Lexon Insurance Company of 10002 Shelbyville Rd, Suite 100, Louisville, KY 40223 as surety, authorized to do business in this State, are held and firmly bound unto the State in the penal sum as indicated, lawful money of the United States, for which payment, well and truly to be make, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors, and assigns jointly and severally, firmly by these presents.

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State, to wit: *(May be used for blanket bond or for single well)*

See attached Exhibit "A"

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of the State and the rules, regulations and orders of the Conservation Commission of the State, especially with reference to the proper plugging of said well or wells, and filing with the Oil and Gas Conservation commission of this State all notices and records required by said Commission, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation is void; otherwise, the same shall be and remain in full force and effect.

Penal Sum of One Hundred Thousand and No/100 ($100,000.00).

Witness our hands and seals, this 28th day of March, 2016.

Principal: Alta Mesa Services, LP

Principal: Michael A. McCabe, CFO

Witness our hands and seals, this 28th day of March, 2016.

Surety (print): Lexon Insurance Company

Surety(signature): Teresa D. Kelly, Attorney-in-Fact

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

Idaho Oil and Gas Conservation Commission

Approval Date: _____

Secretary

POA #LX-264759

Form No. P-2

This bond replaces and supersedes Aspen American Insurance Company Bond No. SU46311 effective March 28, 2016.

State of Idaho
DEPARTMENT OF LANDS

IDAHO DEPARTMENT OF LANDS

Surety Bond Number (b) (6)

Lease/Plan/Permit No(s). See Attached Exhibit "A"

KNOW ALL MEN BY THESE PRESENTS, That we AM Idaho LLC, as principal and Lexon Insurance Company, a corporation organized under the laws of the State of Texas, and having its principal place of business in the State of Kentucky, in the City of Louisville, as surety are held and firmly bound unto the State of Idaho, in the sum of One Hundred Thousand------ dollars ($ 100,000.00) lawful money of the United States, conditioned on the payment of all damages to the surface and improvements thereon of lands described in the above lease/plan/permit specified and any outstanding balances as set forth in the lease/plan/permit. For such payment, well and truly to be made, we bind ourselves, our and each of our heirs, executors, administrators, successors and assignees, as the case may be, jointly and severally, firmly by these presents.

THE CONDITION of the foregoing obligation is such that:

WHEREAS, by lease/plan/permit bearing the above serial number, the lessee/plan holder/permittee was granted specific rights under and pursuant to Idaho Code title 58, chapters 1,3 and 6 or Idaho Code title 47, chapters 7, 8, 13, 15 or 16, and the pertinent rules and regulations of the Idaho State Board of Land Commissioners; and

WHEREAS, said lessee/plan holder/permittee has, by virtue of the lease/plan/permit above referred to, entered into certain covenants and agreements set forth in such lease/plan/permit, under which operations are to be conducted; and

WHEREAS, the said principal, in consideration of being permitted, in lieu of the lessee/plan holder/permittee, to furnish this bond agrees and by these presents does hereby bond himself to fulfill on behalf of the lessee/plan holder/permittee all of the obligations of the said lease/plan/permit in the same manner and to the same extent as though he were the lessee/plan holder/permittee. It is understood and agreed by the surety and the principal that if there is outstanding restoration obligations on the premises, or if outstanding payments are due, this bond shall extend to cover all acts for which restoration is required or payment of such outstanding amounts due, both prior to and subsequent to the date of this bond, until notified in writing by the Idaho Department of Lands that such requirements have been met or the bond has been replaced. The Idaho Department of Lands may require payment of the entire sum of this bond, or portions thereof, upon written notice to the surety, by the department, of the lessee/plan holder/permittee's failure to perform any obligations and/or pay any amounts due under the above referenced statutes and pertinent rules.

The surety shall pay to the Department of Lands the sum of this bond, or portions thereof, as requested by the department within 30 days of receipt of such written notice. In the event of a partial distribution, the remaining funds and liabilities shall not be released until the department notifies the surety, in writing, of release of remaining liability or requires payment of the remaining bond liabilities. Payment of the full sum of the bond to the department shall release the surety of all liabilities and obligations.

NOW THEREFORE, if the above principal shall in good faith observe, carry out and comply with all the laws now existing or hereafter enacted, designed or intended for the protection of the surface owner of said lands against damage and resulting loss caused by any operations carried on under said lease/plan/permit, or if any such damage and resulting loss shall so occur nevertheless, for which damage and loss reimbursement is required and made, then this obligation shall become void, otherwise to remain in full force and effect; and the liability of the surety under this bond for any one or more defaults of the principal under said lease/plan/permit shall not exceed in the aggregate the sum stated herein above; It is further provided, however, that the bond may be cancelled by the surety by the service of written notice of cancellation upon the Director of the Department of Lands of the State of Idaho, such cancellation to be effective at the expiration of ninety (90) days after the service of such cancellation notice by the surety on the Director by registered mail. Such cancellation notice, however, shall not affect any liability that shall have accrued under this bond prior to the effective date of cancellation.

Signed on this 28th day of March, 2016

(Signature of Principal) Michael A. McCabe, CFO

15021 Katy Frwy, Suite 400, Houston, TX 77094
(Business Address)

(Signature of Surety) Teresa D. Kelly, Attorney-in-Fact

10002 Shelbyville Rd, Suite 100, Louisville, KY 40223
(Business Address)

ACKNOWLEDGEMENT OF SURETY

State of Texas)
) ss
County of Harris)

On this 28th day of March, in the year 2016, before me Candace D. Bosheers, a Notary Public in and for the State of Texas, personally appeared Teresa D. Kelly, known to me to be the attorney-in-fact of the corporation that executed the instrument, or the person who executed the instrument on behalf of said corporation, and acknowledged to me that such corporation executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal of day and year first above written.

Notary Public For Harris County, Texas
Residing at: 5444 Westheimer, Suite 900, Houston, TX 77056
My Commission expires January 24, 2020

POA #LX-264760

IDL 1801-29(26) 5-1-2002

ATTACHMENT S: Aquifer Exemption Request

Attachment S is submitted as a separately bound volume with appendices. A digital copy of the Attachment S - Aquifer Exemption Request, is available in the digital folders file.

ATTACHMENT U: Description of Business

U. Description of Business – AM Idaho LLC is the operating subsidiary of High Mesa Holdings, LP. High Mesa Holdings, LP is a privately-held, independent exploration and production company, primarily engaged in the acquisition, exploration, development and production of oil, natural gas and natural gas liquids within the United States.